Biological Services Program

FWS/OBS-79/41
December 1980

ECOLOGICAL CHARACTERIZATION OF THE SEA ISLAND COASTAL REGION OF SOUTH CAROLINA AND GEORGIA

VOLUME II: SOCIOECONOMIC FEATURES OF THE CHARACTERIZATION AREA

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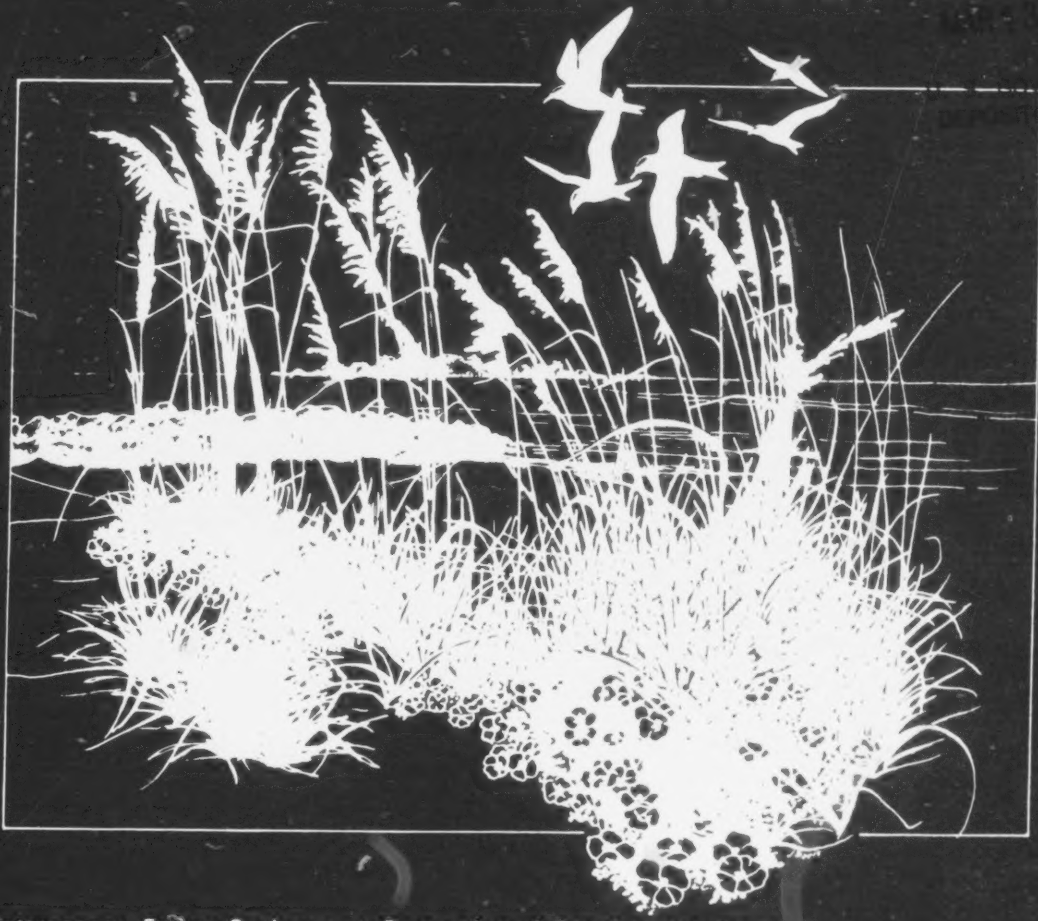

Interagency Energy-Environment Research and Development Program

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
AND
Fish and Wildlife Service

U.S. Department of the Interior

The Biological Services Program was established within the U.S. Fish and Wildlife Service to supply scientific information and methodologies on key environmental issues that impact fish and wildlife resources and their supporting ecosystems. The mission of the program is as follows:

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- To gather, analyze, and present information that will aid decisionmakers in the identification and resolution of problems associated with major changes in land and water use.
- To provide better ecological information and evaluation for Department of the Interior development programs, such as those relating to energy development.

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SOCIOECONOMIC FEATURES OF THE CHARACTERIZATION AREA

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DISCLAIMER

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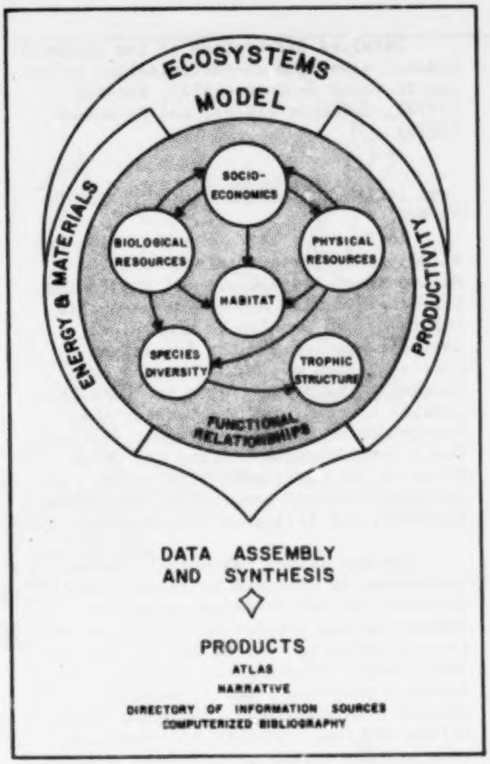
PREFACE

The Sea Island Coastal Region of South Carolina and Georgia is rich in natural resources, including moderate climate, dramatic scenic qualities, fertile soils, water, fish, wildlife, and minerals. These resources are valuable for a variety of often competitive uses, including active and passive recreation, transportation, agriculture, commercial fisheries, industrial development, preservation, and so forth.

A significant trend in the management and development of coastal resources is the growing realization that rational decisions and final judgements can be made only when all available information on local environmental conditions is considered. This trend recognizes the need for a holistic approach and has promoted the ecosystem concept in natural resource management.

Recognition of the need for an ecological approach in managing coastal resources has developed from increasing evidence that man's utilization of this environment has brought about major, yet often subtle, changes in the functioning of ecosystems. In order to perpetuate the economic, aesthetic, and biological values of coastal ecosystems, we must understand their functional relationships. As expressed by Odum (1964), our modern ecology must be a "systems ecology," or a hybridization of both ecology and systems methodology. The theory behind this approach embodies an important ecological principle: an ecological system is comprised of many components, no one of which can be altered without affecting the total system since no one part functions independently. By including a full assessment of the total ecosystem, management efforts - at both the field and administrative levels - can be designed to maximize the economic, social, and biological benefits derived from natural resources. Recognizing this, the U.S. Fish and Wildlife Service is employing the ecosystem concept as a holistic mechanism for managing natural resources and is developing ecological characterization as one basic tool for this application.

An ecological characterization is a synthesis of existing information and data structured in a manner which identifies functional relationships between natural processes and the various components of an ecosystem (Preface Fig. 1). Specifically, objectives of the Sea Island Ecological Characterization were to: 1) assemble, review, and synthesize existing biological, physical, and socioeconomic information and establish a sound information base for decision-making; 2) identify and describe various components (subsystems, habitats, communities, and key species) in this coastal ecosystem; 3) describe major physical, biological, and socioeconomic components and interactions; 4) describe known and potential ecosystem responses to man-induced changes; and 5) identify major information deficiencies for further study and decision-making needs.



Preface Figure 1. Components and final products of an Ecological Characterization of the Sea Island Coastal Region.

Ecological characterizations are designed primarily to assist coastal resource managers engaged in comprehensive planning efforts such as assessment of the environmental impacts of development in the coastal zone. Other applications include the preparation of mitigation procedures and development alternatives. Characterization also provides an immediate data base for specific action programs (offshore oil and gas development, coastal construction permit reviews, etc.) and guidance in selecting parameters that need study in further defining coastal ecological systems.

Detailed discussions of the national coastal ecosystem characterization effort can be found in Tait (1977), Barclay (1978), Johnston (1978), and Palmisano (1978).

SEA ISLAND ECOLOGICAL CHARACTERIZATION

In February 1977, the U.S. Fish and Wildlife Service contracted with the Marine Resources Division of the South Carolina Wildlife and Marine Resources Department to develop an ecological characterization for the Sea Island Coastal Region of South Carolina and Georgia. The project area includes the coastal tier of counties between the Georgetown/Horry county line in northern South Carolina south to the St. Marys River on the Georgia/Florida border, and the three lowland counties of Dorchester, Berkeley, and Effingham (Preface Fig. 2).

The Sea Island Ecological Characterization is designed to yield products that will assist decision makers in evaluating and predicting impacts of man-induced perturbations (e.g., oil and gas development, dredging and filling, water resource projects), and in general coastal zone planning. The study identifies critical habitats and sensitive life history stages of important species, addresses functional interactions at the habitat level, and provides socioeconomic information relative to the coastal environment.

Data assimilated for this project are partitioned into three segments for descriptive purposes: physical features (i.e., geology and hydrology), socioeconomic features (i.e., demographic characteristics and industrial development), and biological features (i.e., an ecological treatment of animals, plants, and their habitats).

The overall framework for the preparation of ecological characterization materials was provided by conceptual models. These conceptual models have been modified for inclusion in the final products to facilitate understanding of ecosystem functions. To accommodate the broadest range of potential users, a three-tier model presentation was used and includes the following elements for each ecosystem: 1) a technical energese model demonstrating energy flow into and within the subject ecosystem, functional relationships among representative components of the system, and flow of energy in various forms from the system; 2) a less technical pictorial model of the same ecosystem illustrating representative flora and fauna; and 3) a representative food web indicating trophodynamics within the subject ecosystem.

Organization of Final Products

Several products are being developed from the Sea Island Ecological Characterization effort, as follows:

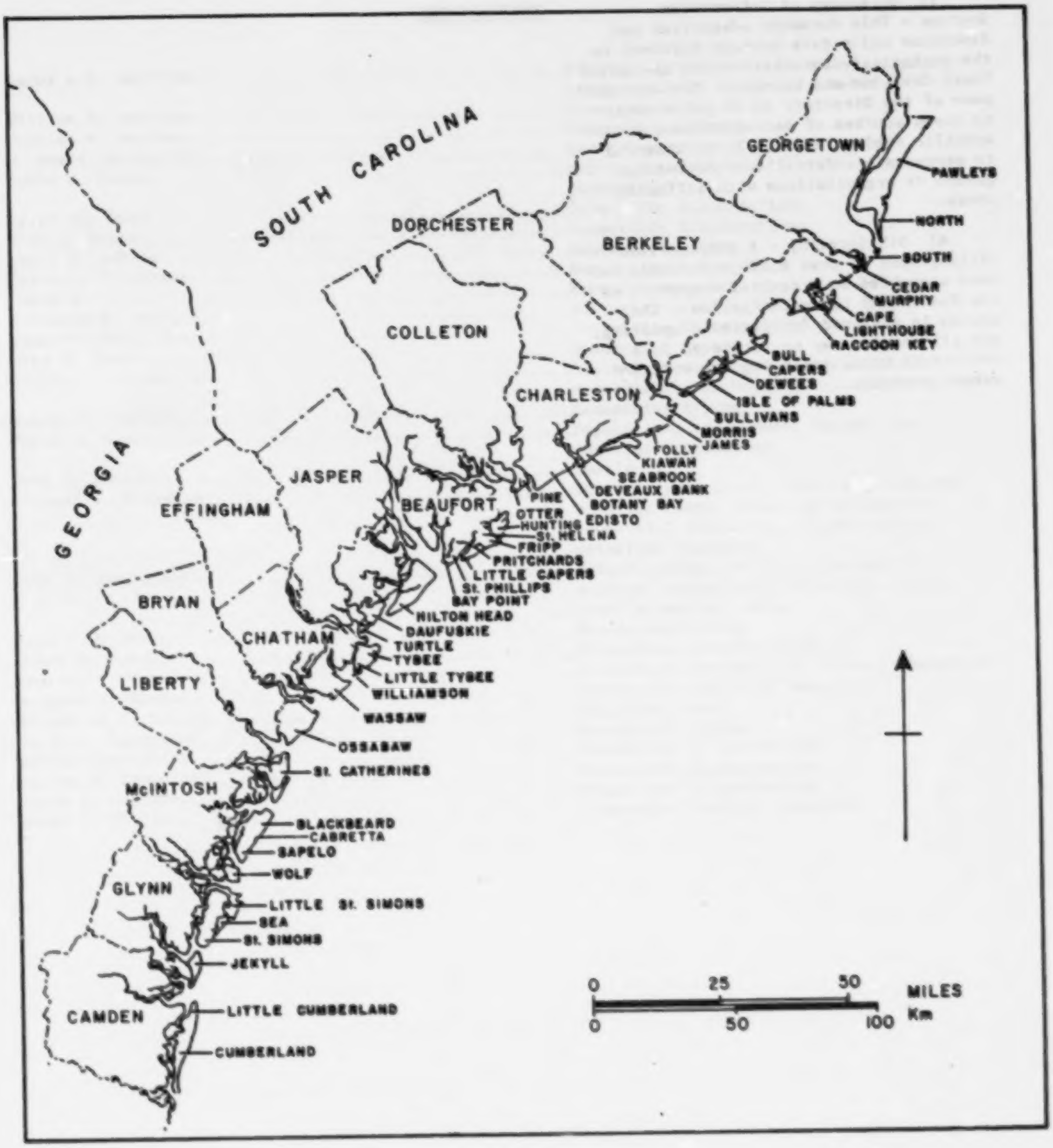
1) Characterization Atlas - the Atlas is an oversized document (28 x 42 in) that presents data in condensed form in several series at scales ranging from 1:24,000 to 1:1,000,000. The Physiographic Series (1:100,000) describes wetlands, physiographic features, ecological habitats, and land use. The Geology Series presents stratigraphic, structural, and geophysical information about the characterization area at several scales. Two topographic series at 1:250,000 and 1:100,000 depict various wildlife, archaeological and recreational resources, military and educational institutions, water quality, spoil disposal, utilities, railroads and airports. Enlargements of the five major urban areas give more detailed information on industries, point source discharge, power plants, etc. All maps are printed in color.

2) Narrative Volumes - Detailed narrative treatment is provided for the three major ecosystem components: the physical, socioeconomic, and biological features of the Sea Island Coastal Region. Because conceptual models are particularly valuable in identifying ecosystem components and in relating their functional significance and regulatory processes, appropriate sections of the narrative text are prefaced by exemplary models. These models serve as a tool to promote understanding of the functional relationships within and between systems, and the impacts of various impingements and perturbations on their components. Narrative materials are arranged as follows:

a) Physical features section - Detailed treatment is provided for topical areas such as climate, physiography, geologic history and structure, coastal and nearshore erosion and deposition, hydrology, and descriptions of individual coastal islands of the study area.

b) Socioeconomic features section - Data are presented on population, labor force characteristics and trends, transportation, industrial development, agricultural practices, public utilities, energy resources, fish and wildlife conservation and utilization, and recreational resources.

c) Biological features - This section describes biotic components along ecological lines. This approach facilitates the treatment of major community or habitat types, and generally deals with organisms at the population level. Functional relationships and areas of ecological sensitivity are stressed.


SOUTH CAROLINA
GEORGIA
GEORGETOWN
PAWLEYS
NORTH
SOUTH
CEDAR
MURPHY
CAPE
LIGHTHOUSE
RACCOON KEY
DORCHESTER
BERKELEY
COLLETON
CHARLESTON
BULL
CAPERS
DEWEES
ISLE OF PALMS
SULLIVANS
MORRIS
JAMES
FOLLY
KIAWAH
SEABROOK
DEVEAUX BANK
BOTANY BAY
EDISTO
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BEAUFORT
PINE
OTTER
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St. HELENA
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PRITCHARDS
LITTLE CAPERS
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BRYAN
CHATHAM
TURTLE
TYBEE
LITTLE TYBEE
WILLIAMSON
LIBERTY
WASSAW
OSSABAW
St. CATHERINES
McINTOSH
BLACKBEARD
CABRETTA
SAPELO
WOLF
GLYNN
LITTLE St. SIMONS
SEA
St. SIMONS
JEKYLL
CAMDEN
LITTLE CUMBERLAND
CUMBERLAND
0 25 50 MILES
0 50 100 Km

Preface Figure 2. Study area of the Sea Island Coastal Region.

3) Directory of Information Sources - This document identifies and describes major data sources relevant to the ecological characterization of coastal South Carolina and Georgia. The main purpose of the Directory is to guide users to known sources of data pertinent to specific subject areas. It is intended to serve as a referral service between groups or organizations with differing needs.

4) Bibliography - A computerized bibliography of over 8,000 references has been assembled as a central component of the Sea Island Characterization. The system is designed for periodic updating, and all entries can be retrieved in a variety of ways, including key word and author searches.

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CHAPTER ONE

INTRODUCTION

There are a number of socioeconomic changes occurring simultaneously in the Sea Island Coastal Region of South Carolina and Georgia. Although it is difficult to isolate the effects of any single changing force, it is likely that they are all closely interrelated in producing new demands on natural resources of the study area. Of particular importance to the socioeconomic base of the coastal area is the fact that individuals, populations, and communities are not static entities; they change in direction, influenced, at least partly, by their history and environment.

The purpose of this document is to develop a comprehensive characterization of the human use environment of the Sea Island Coastal Region. This is a companion text to the physical and biological characterizations. Development of accurate ecological studies requires superimposing activities of man on the natural bio-physical environment. It is hoped that the information provided herein will be useful to public decision makers, planners, field biologists, and other citizens in formulating coastal resource management strategies.

Basically, the Sea Island Coastal Region of South Carolina and Georgia has developed over the last three centuries into an ecosystem that is strongly influenced by three major components: 1) agriculture, 2) urbanization, and 3) natural factors. All of these components function as systems and are interrelated through a flow of energy in the Sea Island regional ecosystem (Fig. 1-1). The natural system, composed of the seven major ecosystems identified in this study and a combination of energy sources, directly influences the agricultural and urban systems through a flow of natural resources, i.e., land, water, and oxygen. The general relationships of the socioeconomic environment can be identified in Figure 1-1. As depicted, natural resources are needed by the socioeconomic

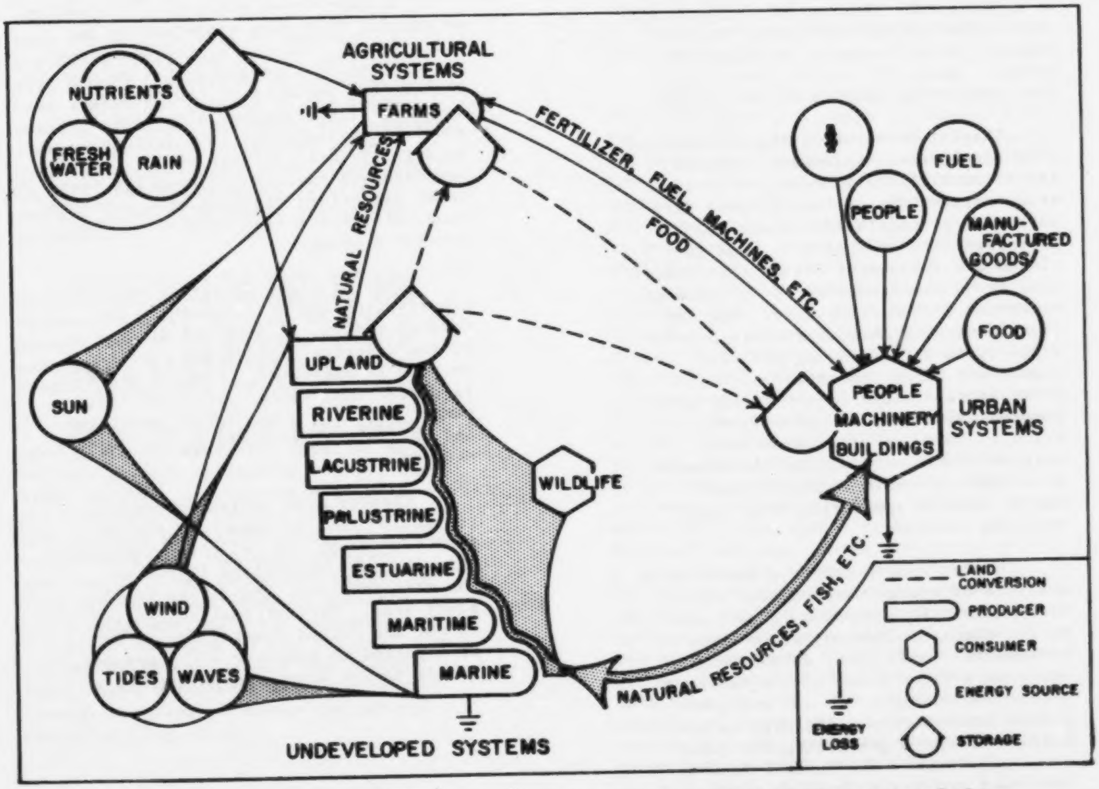
AGRICULTURAL SYSTEMS
FARMS
NUTRIENTS
FRESH WATER
RAIN
FERTILIZER, FUEL, MACHINES, ETC.
FOOD
NATURAL RESOURCES
$
PEOPLE
FUEL
MANU-FACTURED GOODS
FOOD
SUN
UPLAND
RIVERINE
LACUSTRINE
PALUSTRINE
ESTUARINE
MARITIME
MARINE
WILDLIFE
PEOPLE MACHINERY BUILDINGS
URBAN SYSTEMS
WIND
TIDES
WAVES
NATURAL RESOURCES, FISH, ETC.
UNDEVELOPED SYSTEMS
LAND CONVERSION
PRODUCER
CONSUMER
ENERGY SOURCE
ENERGY LOSS
STORAGE

Figure 1-1. Flow of energy in the natural and socioeconomic environments of the Sea Island Coastal Region (adapted from McPherson et al. 1976).

environment for nutrient exchange, biological diversity, habitat maintenance, wildlife productivity, and environmental quality. Once altered, the natural system ceases to function as a total system and the effects are transferred to the socioeconomic environment.

This volume consists of chapters dealing with the socioeconomic environment of the study area. In many cases, it was necessary to present data on a county by county basis rather than in a consolidated form for the general study area. In other cases, specific data by county were not available and broad generalizations were made for the entire area based on the best information available. It should be noted that these data, descriptive as they are, constantly change. This is especially true of Chapter Three which includes detailed census data that are taken only at 10-year intervals. However, the data should provide a useful baseline for general comparative analyses and historical trends.

Chapter Two introduces the study area through an historical account of major events leading to socioeconomic development of the Sea Island Coastal Region. Major emphasis is placed on events, especially earlier ones, that have shaped the destiny of the region.

Chapter Three describes and quantifies population, employment, income, and industrial characteristics of the study area. Critical demographic factors such as population trends are discussed in this chapter. Also included are employment trends that contribute to an understanding of the economic structure of the study area. The sections on income characteristics provide a yardstick for measuring the past growth and future potential of the study area. Income is one of the more comprehensive measures of economic activity that can be compared on a regional basis. Industrial development is another economic indicator that can be used in appraising long-range regional trends.

Chapter Four presents a descriptive analysis of energy resources of the study area. This section is pertinent to the characterization, since Outer Continental Shelf (OCS) development has been a major focus of the nation's search for energy. OCS oil and gas production has many influences on the coastal economy, generating new jobs, new tax revenues, new Federal funds, new costs and taxes, and new environmental risks. For many industries and all levels of government, OCS development requires decision-making.

Chapter Five deals with transportation systems within the study area. The three major modes of transportation - water, ground, and air transportation - are discussed in terms of their economic significance. Port facilities are of particular interest in this section, since they are a vital link in commercial trade between the study area and a much broader geographic zone.

In Chapter Six, the authors have described the development of agriculture in the study area. Modern agricultural systems, no less than urban systems, may be regarded as artificial ecosystems that continue to function only as a result of extensive human manipulation. In this chapter, trends are shown from the traditional paleotechnic agricultural system in which human and animal labor predominated to modern neotechnic systems of agriculture where technology is the dominant force of production. The section on land use trends and their effects on the coastal environment is particularly applicable to coastal resource planning needs.

Chapter Seven presents a discussion on coastal fisheries conservation and utilization. General historical trends are emphasized throughout this section. The various segments of the fishing industry (i.e., shrimp, blue crab, and finfish fisheries) are discussed in detail. Descriptions of the fisheries resource base, the harvesting sectors, marketing, economic, and conservation factors are also related to the coastal economy.

Chapter Eight discusses wildlife conservation and utilization in the coastal region. A detailed discussion of the waterfowl and upland game resources is presented. Special emphasis is placed upon hunter participation, hunter success, conservation practices, and the role of wildlife in the coastal economy.

Chapter Nine addresses coastal recreation and its impact on the region's economy. As reflected throughout this chapter, recreation is one of the most important industries in the study area. Recreational activities in the Sea Island Coastal Region can be expected to increase with consumer trends toward water-based leisure.

CHAPTER TWO

HISTORICAL DEVELOPMENT OF THE SEA ISLAND COASTAL REGION OF SOUTH CAROLINA AND GEORGIA

I. INTRODUCTION

The character of any region is influenced by events occurring not only within the region, but also by those occurring in the area surrounding it. The States of South Carolina and Georgia are no exception. Present borders do not coincide with earlier ones; the original Carolina Grant extended across the continent from the Atlantic to the Pacific oceans. Therefore, current State and county borders meander indiscriminately across past political, ecclestiastical, and private boundaries. In an effort to develop a well-defined historical characterization of the coastal area under study, available data from a variety of sources have been assimilated.

Although a history of neither South Carolina nor Georgia is the purpose of this section, it will be necessary to provide a brief overview of some statewide events, especially early ones, that have shaped the destiny of the coastal region. Initial settlement and eventual independence were influenced largely by international activities; therefore, it will also be necessary to briefly examine selected European events and policies.

Settlement of the coast was apparently an act of Indian migration from distant regions. In order to give proper perspective to the prehistoric Indian population, a very broad view of early events in Northern America is necessary.

During the mid-1800's the coastal area underwent extensive physical modification, as vast wilderness swamps, forests, marshes, and bays were altered for rice culture. During this period the original Sea Island ecosystem, which had evolved over thousands of years, gave way to a new three-part ecosystem. This system incorporated an agricultural component, an urban component, and a natural component of the original ecosystem, which was largely undisturbed. Today these components are interrelated through the flow of energy and natural resources (Fig. 1-1).

II. PREHISTORIC OCCUPATION

A. PALEO-INDIANS - 10,000 B.C. TO 6000 B.C.

From the arrival of the Paleo-Indians until the time of European settlement of the coast, the historic occupation of these inhabitants spans approximately 12,000 years. The first people to occupy the coastal plain of the present Southeastern United States entered the area, probably from the west, about the 10th millenium B.C. These aborigines, known as Paleo-Indians, were characterized by hunting, especially of larger game, and the use of spears and chipped stone tools (Ferguson 1974).

B. ARCHAIC PERIOD - 6000 B.C. TO 2000 B.C.

Following the Paleo period, a new era developed, the Archaic Period, lasting from 8 to 4 thousand years ago. Migration was very frequent during this period. The occupation span was so long and movement so often that these Indians lived in practically every desirable place in Georgia and South Carolina. Characteristics of the early Archaic Period included improved stone tools, such as axes, the development of weights for spear throwers (atlatl) and the first use of pottery. The oldest pottery yet found in North America has been found in South Carolina near the Savannah River (Ferguson 1974).

During the late Archaic Period, there was a general surge of human activity. Populations became somewhat larger and areas were inhabited for longer time periods, probably indicating a more knowledgeable exploitation of the available food supply. Along both the South Carolina and Georgia coasts, utilization of shellfish, particularly oysters, seems to have been an important factor that possibly contributed to a more sedentary life style (Larson 1969). Both shell rings and middens, formed from accumulating shellfish refuse, are still evident at some occupation sites. Shell middens are recorded throughout the entire coastal areas. Shell rings, which are well-defined circular shell structures, are found from Sewee Bay, South Carolina southward to Sapelo Island, Georgia (Edwards 1965) and span both Archaic and Woodland Periods. These are peculiar to this section of the coast and are not known to appear elsewhere in North America. Several have been investigated archaeologically and, although there are many divergent theories, no indisputable conclusions of their original purposes have been derived. A representative example of these unusual structures is the one located, near the mid-point of their distribution, at Fig Island on the west bank of the North Edisto River (Fig. 2-1). This example is about 250 ft (75 m) in diameter and encompasses an area of approximately one-half acre

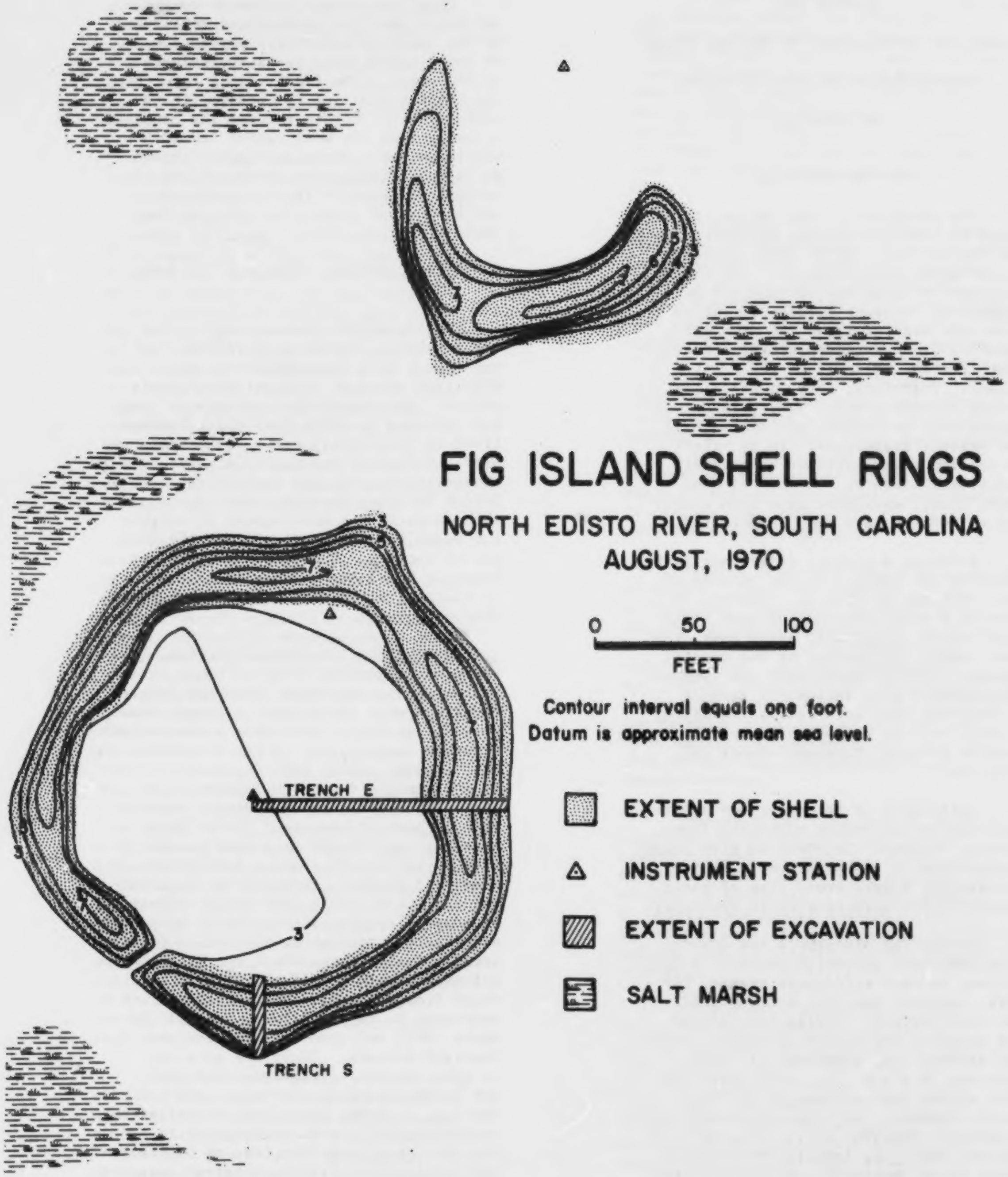
FIG ISLAND SHELL RINGS
NORTH EDISTO RIVER, SOUTH CAROLINA
AUGUST, 1970
0
50
100
FEET
Contour interval equals one foot.
Datum is approximate mean sea level.
EXTENT OF SHELL
INSTRUMENT STATION
EXTENT OF EXCAVATION
SALT MARSH
TRENCH E
TRENCH S
3
5
7
3
3
5
7
7
3
7
3

Figure 2-1. Fig Island shell ring and partial second ring on west bank of North Edisto River (Hemmings 1970).

(.2 ha). Its height is about 5 ft (1.5 m) above the surrounding marsh and its base averages 35 ft (10.7 m) in thickness. It is composed almost entirely of oyster shell, the volume of which is no less than 375,000 U. S. bushels.

C. WOODLAND PERIOD - 2000 B.C. TO 1000 A.D.

During the early Woodland Period, lasting from about 2000 B.C. to about 1000 A.D., the bow and arrow were introduced and ground stone axes appeared. A small amount of gardening began to supplement hunting and gathering. Village sites became larger as did the population. Trade expanded and religious activities increased. Unlike on Paleo and Archaic sites, pottery fragments are more commonly found on Woodland sites (Ferguson 1974).

D. MISSISSIPPIAN PERIOD - 1000 A.D. TO EUROPEAN CONTACT

About 1000 A.D., during a time known as the Mississippian Period, squash and beans were introduced, probably from Mexico, into eastern North America. Land was cleared and small scale farming was begun. Some towns grew large enough to cover hundreds of acres. Emphasis on religion became more common. By 1400 A.D., the Piedmont and coastal plain of South Carolina were the eastern frontier of the Mississippian culture (Ferguson 1974). Most of the recorded prehistoric archaeological sites in the Georgia and South Carolina coastal area appear to be of either the Woodland or Mississippian periods.

III. HISTORIC CONTACT

At the time of the first contact with European explorers, Indians of the coast were in the last Mississippian Period. Indians who inhabited this area, according to ethnologists, belonged to the Iroquoian, the Muskhogean and the Eastern Siouan tribes (Milling 1969, Rogers 1970). Other tribes included the Timucuans, Guales, and Yemasees of Georgia, and the Yemasees, Cuaboys, and Yuchis of South Carolina (Milling 1969, Hudson 1976). Probably no more than 50,000 Indians, living in villages of 50 to 200 individuals, inhabited the Georgia and South Carolina coastal plain during the initial period of contact with Europeans. Generally, these Indians shared certain common traits. All had developed a fairly diversified agriculture; they built increasingly substantial dwellings and lived in villages. Although varying widely with specific tribes, their culture was based primarily upon the cultivation of food crops with very important, but secondary, emphasis on hunting (Milling 1969).

Although recorded prehistoric occupation spanned more than 100 centuries, the coastal Indians developed a subsistence technology that did not appreciably alter their environment. Hunting, agriculture, and limited manufacturing practices have left little or no readily perceptible evidence of prehistoric occupation on the landscape. Pottery, weapon fragments (e.g., arrowheads), and shellmiddens and rings are the most obvious evidence of the Indian's presence.

A. EXTINCTION OF COASTAL TRIBES

War among various tribes contributed to their eventual destruction. However, diseases such as smallpox, excessive liquor furnished by traders, and most of all enslavement contributed further to the destruction of the small coastal tribes. By 1683, the Proprietors, who managed Carolina, had given the colonists permission to sell Indian captives in the West Indies. This soon stimulated the trade because it was impossible to distinguish between Indians captured in war or simply taken for profit. Eventually, more Indian slaves were exported from South Carolina than from any other colony. After a brief war with the settlers in 1717, all Indian survivors were shipped to the West Indies (Rogers 1970). Treatment was much the same for all coastal Indians, although slavery probably was not as severe a threat for those in Georgia.

By 1720, the coastal tribes had lost their separate identities, and by about 1755, they had completely disappeared (Rogers 1970). After the Eastern Siouan tribes of the South Carolina coast were reduced in numbers, they apparently coalesced with the Catawbas, the only South Carolina tribe able to maintain its cultural identity. Georgia coastal Indians were formally granted land by the British, through cessions in 1733, from the Savannah to the Altamaha River and in 1763 from the Altamaha to the St. Marys River (Coulter 1947). As the English migrated southward, occupying the coast, many Indians found an ally in the Spanish. They eventually moved or were forced into Florida for protection by the Spanish at St. Augustine. By the time of the American Revolution, Indians no longer inhabited the coast of South Carolina and Georgia.

B. THE EUROPEANS - HISTORIC OCCUPATION

1. Exploration and Early Settlement

The first Europeans to land in South Carolina were presumably the Spanish (Wallace 1951, Rogers 1970). Late in 1520, Lucas Vasquez de Ayllon sent a ship from Santo Domingo to explore the Atlantic coast of North America. The ship joined another vessel from Santo Domingo and both proceeded, against Ayllon's orders, to obtain Indian slaves.

On June 24, 1521, near latitude 33 degrees 30 minutes, they sighted land near present-day Georgetown. The crew entered Winyah Bay and explored the surrounding area. The region, called Chicora by the natives, was claimed by the Spaniards. Indians were entertained on board the vessels and suddenly taken to sea as captives. One of the vessels eventually sank; the other reached Santo Domingo and reported to Ayllon (Wallace 1951).

In 1526, Ayllon himself finally sailed to the mainland. In July of that year, his small fleet left Santo Domingo with 89 horses and 500 men, women, and children, including Negro slaves (Savage 1968). Landfall was made at about 33 degrees 40 minutes, which was almost certainly the present-day Cape Fear River in North Carolina. Conditions and reports convinced him to locate his settlement further south.

After travelling southward some 40 to 45 leagues, the fleet reached a larger river, which they called the Gualdape, and Ayllon established the settlement of San Miguel de Gualdape (Quattlebaum 1956). This was the earliest known European settlement in either South Carolina or Georgia. The intervening centuries have obscured its exact location, but the settlement was probably in some area of Winyah Bay or the Waccamaw Neck.

In June 1534, Hernando De Soto landed at Tampa Bay, Florida, and by 1540, he and his explorers traversed Georgia to a site about 25 miles south of present day Augusta on the Savannah River. Quite possibly he ventured into South Carolina before turning westward into Alabama and beyond. In 1561, Spanish explorers under Angel de Villafane visited the coast near Port Royal, South Carolina, and took formal possession of the land in the name of Philip II, King of Spain (Anderson et al. 1974).

The French, led by Jean Ribaut, settled briefly in 1562 in the Port Royal area, but the settlement was soon abandoned. Pedro Menendez de Aviles, in response to this foreign intrusion, founded St. Augustine in 1565 as a bastion of Spanish authority in North America. In 1566, he established a fort, with a garrison of 30 men, at Santa Catalina (St. Catherines Island) (Lanning 1935, Anderson et al. 1974). This was apparently the first in a chain of Spanish settlements on the Georgia coast that was known at the time as Guale.

In 1629, Charles I asserted British claims to North America as far south as the current Florida border. Based upon the discoveries (c.1500) of Sebastian Cabot, he granted to Sir Robert Heath ". . . all of America from sea to sea between North latitude 36 and 31 degrees under the name of Carolana (sic)" (Wallace 1951).

After an unsuccessful settlement on the Cape Fear River in the 1660's, and after much hesitation, a successful British settlement was established at Charles Towne (Charleston) in 1670 (Wallace 1951). The settlement was a commercial venture designed to make a profit for the Carolina Proprietors.

The late seventeenth and early eighteenth centuries were characterized by continuous struggles between the Spanish and English for the contested territory along the South Atlantic coast. Even during nominal peace, there were numerous intrigues with the Indian tribes to encourage turmoil.

Spain, realizing that the ever-expanding English settlements along the South Atlantic coast posed a threat to her sovereignty in the area, launched several military operations against the interlopers. A major attack was directed at Charleston in 1704 and another at Saint Simons in 1743. Both attacks failed, ultimately leaving the British in firm control of the area north of Florida.

2. Beginning of Agriculture (see also Chapter Six)

The early settlers planted mostly subsistence crops, although agricultural experiments with commercial crops were conducted almost from the beginning. Indian trade, especially in deerskins, supplied the major export in the early years. As the Indian trade along the coast dwindled, the emphasis changed first to naval stores obtained from the forests, and then more to indigo and rice. Even as late as the 1720's, the production of pine pitch and tar was more profitable than growing rice (Rogers 1970). By 1718, rice cultivation was extensive along the Santee River, having expanded from Charleston to the Santee/Winyah Area and to the Combahee/Beaufort region (Chapter Six). Later, as Georgia was secured, cultivation expanded to and across the Savannah River.

After the mid-eighteenth century, rice and its attendant culture dominated along the major tidewater rivers of both States. In the Santee/Winyah area, the insular effects of the waterways allowed a distinct society to develop, at the center of which, until the twentieth century, was the rice plantation (Rogers 1970). The generally confining topography of all South Carolina rice plantations encouraged this type of social development.

After the American Revolution, indigo declined in importance. Cotton, the great staple crop of the South, did not become important until the early 1800's. For most of the eighteenth century, rice was the major agricultural enterprise in the Sea Island Coastal Region.

3. Rice Production (see also Chapter Six)

During the early period of rice cultivation, fields were located away from the coast. One of the more readily apparent features of the Sea Island Coastal Region today is the extensive system of rice field dikes, canals, and reservoirs still visible adjacent to many coastal rivers. Gradually, cultivation was brought closer to the tidal estuaries. By the end of the eighteenth century, tidal action was used to flood rice fields (Wallace 1951). Rice was successfully grown from the St. Marys River in southern Georgia to the Cape Fear River in North Carolina, with the greatest production centering around the Georgetown/Santee area in South Carolina (Gray 1941).

Although the Civil War and its aftermath did not immediately destroy the South Atlantic rice culture, it did speed its final decline. With the South's defeat, the slave labor force vanished overnight. The ex-slave, with somewhat naive ideas of his newly found freedom, was inclined to view his new circumstances as free not only from ownership but also from labor (Jones 1971). Capital, as well as labor, was scarce and the industry was never able to fully recover.

4. Rise and Fall of Local Rice Mills

By 1698, sufficient rice was being produced in South Carolina to prompt the colonial authorities at Charleston to request that the Proprietors ". . . would Procure and Send us, by ye first opportunity a model of a Rice Mill" (Gray 1941). Perfection of rice mills was evidently slow as by 1733 a legislative act was passed to encourage the invention of a machine for ". . . the more expeditious beating or pounding of rice . . ." (Gray 1941).

During the last quarter of the eighteenth century, several machines were developed in South Carolina utilizing animal power for beating rice. Threshing mills were experimented with on the Savannah River in the 1830's and, after steam power was employed, were quickly perfected.

By 1851, stationary steam threshing machinery had been improved to the point that up to 1,000 bushels a day could be processed. These machines were expensive, costing from $3,000 to $7,000 in the 1850's; therefore, only the most progressive planters were likely to employ them. Many costly mills, combining the process of milling, grinding, winnowing, screening, and polishing had, however, been constructed on Georgia and South Carolina plantations during the first half of the nineteenth century. The dual expenses of constructing and operating such rice mills were so great that only the very large planters could bear the costs, which ranged from about $10,000 to $18,000 during this period (Gray 1941).

Gradually, there was an increasing tendency to export threshed unmilled rice, or "paddy," to be milled in Europe. The shipment of "paddy" rice directly to Europe is claimed to have begun on an extensive scale in 1823. In the decade immediately before the Civil War most exported rice was "paddy." This export practice led to an eventual decline of the local or plantation mills which were gradually abandoned. Of the several mills constructed along the Santee River before 1861, only three were still standing by the late nineteenth century (Doar 1936). Ruins of these and some Georgia mills, such as the steam mill on Butler Island, can still be located (Cate 1955).

By 1855, several large commercial rice mills were in operation in Charleston and Savannah, but were probably milling rice mainly for domestic consumption (Gray 1941). The mills continued in use until the final abandonment of rice as a commercial crop of the region during the early twentieth century (Doar 1908, Heyward 1937).

After the destruction of the slave system (with the Civil War), the limited availability of suitable labor precipitated the decline of rice production and its existing culture. This decline of the work force, along with the economic disasters accompanying the hurricanes of this time, hastened the decline of the rice industry. Prevailing labor conditions, lack of adequate capital, and competition from other areas, especially after the hurricanes of 1893 and 1910/1911, did not permit recovery. After 1900, many of the abandoned rice fields and surrounding high lands were acquired primarily for the purpose of waterfowl hunting (Rogers 1970).

5. Summer Villages

During the summer, the prevalence of malaria near the coast necessitated a retreat, for those who could afford it, to healthier locations. Some of the planters went to Charleston or other cities, but others preferred to stay closer to their homes and businesses. In South Carolina, Santee River area planters established summer villages on Cedar, Murphy, and South islands at the mouth of the Santee River (Doar 1908, 1936). Dwelling remains can still be located on these islands.

Ashley and Cooper river planters, as well as others, went to urban locations in Beaufort, Charleston, Georgetown, and Summerville, the latter having been firmly established as a resort in 1830 upon construction of a railroad (Bull 1972). Many small, unpretentious country villages were established in South Carolina at such places as Fort Johnson and Secessionville. Coastal Georgia planters followed much the same patterns, some preferring Brunswick or Savannah, some retreating to summer homes in villages such as Waynesville.

Near the end of the nineteenth century, mosquitoes, and not the unhealthy night air or "miasmas" which had been thought to arise at sunset from coastal swamps or marshes, were recognized as the carriers of malaria. James Dent, owner of Hofwyl Plantation in Glynn County, Georgia, was an early (c. 1903) pioneer in the screening of windows and doors to prevent contraction of malarial fever (Cate 1955). Other effective countermeasures, such as draining swamps, were soon practiced. Eventually, the original purpose of the summer villages vanished. Some, like the one at Fort Johnson, were gradually abandoned and disappeared while others, such as Summerville, grew to become extensive residental towns.

6. Storms

Storms have regularly struck the Georgia and South Carolina coasts. (See Volume I, Chapter Four for a discussion of climatology.) One of the first recorded hurricanes in the study area struck at Charleston in August 1686 (Ludlum 1963). Approximately 12 others struck the Georgia-South Carolina coast during the remainder of the seventeenth and eighteenth centuries. All were destructive. Descriptions of flooding, ships driven ashore, and buildings destroyed indicate that extensive damage was caused at Charleston in 1713, 1728, and 1752 (Tannehill 1938).

During the nineteenth century, about 19 storms of hurricane intensity reached the Georgia-South Carolina coast. Of these, the first hurricane, which occurred on September 7, 1804, and another that occurred in August 1893, were the most memorable. The earliest (1804) great West Indian storm of the century reached the South Atlantic coast near Savannah, causing immense damage on the coasts of South Carolina and Georgia (Tannehill 1938). The hurricane of 1822 destroyed the planters' summer villages on North, Cedar, and South islands. The villages were apparently never rebuilt. Most of the rice crop was destroyed and many slaves, especially in the lower fields, were drowned.

After the 1822 storm in the Santee Delta, planters built places of refuge, called storm towers, on the delta and islands for the field hands. These towers were cylindrical, about 25 ft (7.6 m) in diameter, 20 ft (6.1 m) high and were constructed of brick. They were covered with conical roofs and had an entrance about 10 ft (3 m) above the ground. The structures resemble the military Martello tower of the period; however, the storm towers were not as heavily constructed as the military towers. As far as has been ascertained, the storm towers were not duplicated elsewhere and are unique to the region. They were used to some advantage during the hurricane of 1893, which dealt one of the final blows to the Georgia-South Carolina rice industry. Only two towers still exist; one, on the delta on Moreland Plantation, is utilized as a private hunting club headquarters, and one on Murphy Island is not used, as the interior has been destroyed (Fig. 2-2).

Possibly the most disastrous hurricane ever recorded to have reached this coast occurred in August 1893. It struck the coast between Charleston and Savannah and was ". . . accompanied by a tremendous wave which submerged the islands. . ." (Tannehill 1938). Property damage was estimated to be in excess of $10 million, a large sum for the period. The known loss of life exceeded 1,000 persons. The rice planters suffered particularly heavy losses in crops, fields, equipment, and dikes. The rice industry never fully recovered and declined rapidly after this storm.

The hurricane of October 1910, which closely paralleled the study area coastline, and the less severe storm of August 1911 that passed inland between Charleston and Savannah, were the last disastrous storms to affect rice culture before rice ceased to exist as a commercial crop (Heyward 1937).

7. Game Preserves

After the hurricanes of 1893 and early 1900's had destroyed commercial rice culture in Georgia and South Carolina, some fields were unused. During this period, wealthy sportsmen, generally not natives of the area, discovered the value of the abandoned rice fields for

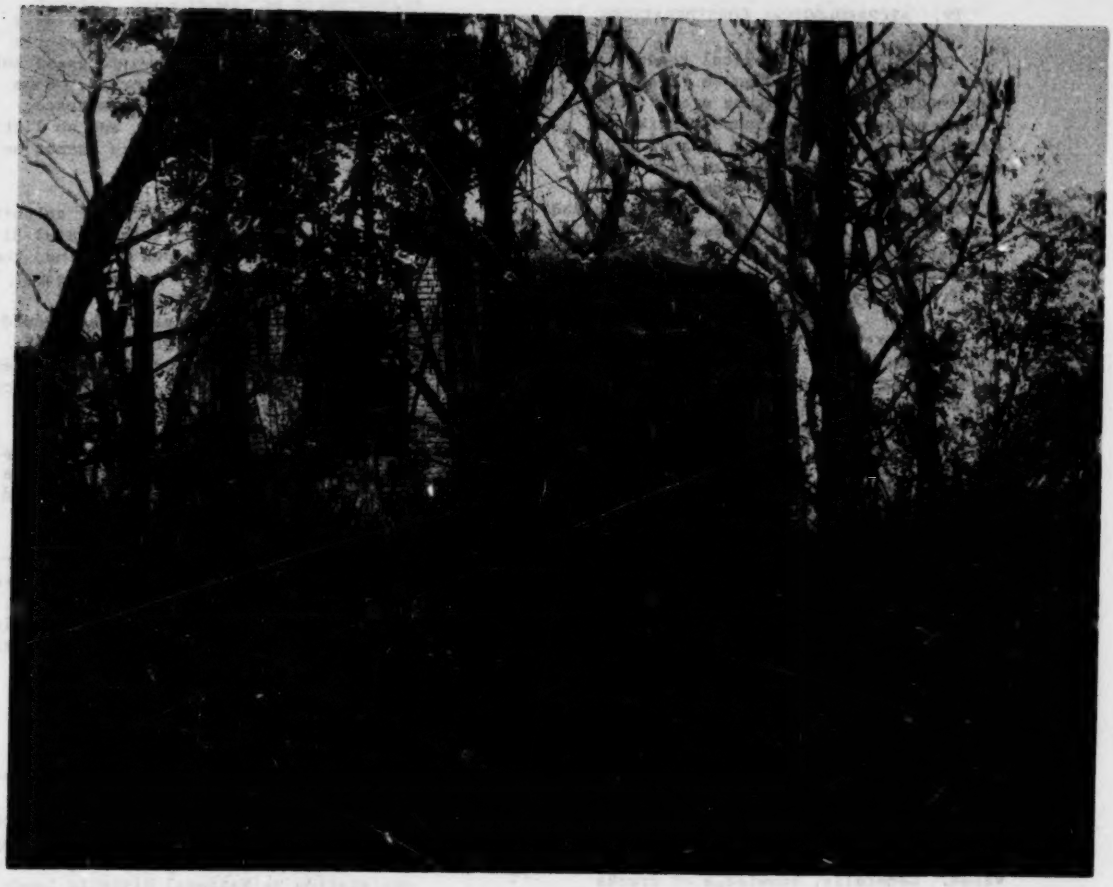

Figure 2-2. Hurricane Tower in the Santee Delta erected in the late 1800's (photo by W. J. Keith, S.C. Marine Resources).

duck hunting, both for business promotion and personal use. The attractiveness of these fields for waterfowl gradually diminished as the untended dikes allowed natural succession to convert the fields into needlerush and cordgrasses (Newsom 1968). The development of mechanized construction equipment, especially draglines, soon provided a feasible means of restoration, resulting in the increasing degree of scientific waterfowl management which is now practiced (see Chapter Eight).

Areas such as those in the lower Savannah River region, Butler Island in the Altamaha River, portions of the South Edisto River at Bear Island, and the Santee Delta, eventually were owned and managed either by State or Federal governmental entities as public management areas or refuges. In recent years, the expense of maintenance and ever-increasing property taxes have discouraged private ownership of game preserves.

Events in the lower Santee River region illustrate typical aspects of the sequential acquisition, consolidation, and development of a waterfowl management area. When E. P. Alexander advertised his North and South island property about 1907, such notables as President Grover Cleveland had hunted there. He persuasively presented them for sale as not being surpassed by lands found elsewhere ". . . with superior attraction for a magnificent and permanent game preserve . . ." (Alexander 1908). The Santee Gun Club eventually bought 12 rice plantations and controlled about 20,000 acres (8,094 ha) in the Santee Delta (Rogers 1970). In 1975, the Santee Club donated its holdings to the Nature Conservancy for establishment of a refuge now known as the Santee Coastal Reserve. T. W. Yawkey bequeathed his holdings on North and South islands and Cat Island to the State of South Carolina in 1976. They are now administered under the terms of his estate as a game preserve.

IV. ARCHAEOLOGICAL CONSIDERATIONS

Intensive archaeological reconnaissance has been undertaken on relatively few locations in the study area. Additional unknown sites probably exist in many locations on the sea islands and coastal plain. Most site records contained in the files of State archaeologists have been placed there by interested laymen and are not the products of any scholarly research. Generally, site records contain only brief descriptions or, frequently, no description at all.

Much more is known about historic and archaeological sites on land than those located underwater, but additional sites are continually being discovered. In South Carolina alone, 914 new sites were reported during the first 6 months of 1978. This is a 34.8% increase in the total State site inventory (Drucker 1978). Indian occupation began about 10,000 B.C. and produced many sites. The European development of the region also produced innumerable historic sites. Wars have added additional important sites.

There is very incomplete knowledge of shipwrecks and almost no knowledge of prehistoric habitation sites that may now be underwater. Historic shipwrecks on the South Atlantic coast could span almost a 500-year period. Shipping has been closely associated with early development and settlement. War and severe storms increase the number of wrecks which are sometimes of unique value. Generally, knowledge of wrecks rapidly decreases with the distance from shore. No underwater habitation sites are known to be within the study area; however, geological and archaeological evidence point to their possible existence (U.S. Department of Interior, Bureau of Land Management 1977a). It is possible that such sites are located offshore to a depth of approximately 130 ft (39.6 m), the maximum exposure of the seabed at the time of appearance of Paleo-Indians about 12,000 years ago. Since there is a great deal of evidence to suggest that later prehistoric Indians tended to concentrate near the coast, it might be logically assumed that Paleo-Indians did likewise. This would place possible habitation sites about 50 mi (80.5 km) into the ocean near Georgetown, about 60 mi (96.6 km) off Savannah and about 65 mi (104.6 km) off Brunswick (U.S. Department of Interior, Bureau of Land Management 1977a).

Within counties forming the study area, there are hundreds of archaeological and historic sites. Additional ones may be reported at any time. Many historic sites are known to be present in some areas, but are not officially recorded. Many high land prehistoric habitation sites are known to exist but are also officially unrecorded. Some sites could rank high in importance, some of lesser importance, and so little is known of others that they cannot be ranked at all.

Known recorded significant cultural sites are indicated on Atlas plates 31 - 40. In both Georgia and South Carolina, the official custodians of archaeological site reports are the State archaeologists. Generally, the records of the State archaeologists, maps of Georgia Department of Natural Resources, studies of the Regional Planning Councils, documents of the United States Bureau of Land Management, and the National Register of Historic Places (with supplements) have been used to determine the locations of sites that are delineated in the Atlas. The Atlas contains the most complete listing of significant sites available at this time. However, it should not be used as the sole source of information for planning purposes; rather the appropriate State authorities should be consulted for specific locations and complete site descriptions.

V. HISTORIC LANDMARKS

Buildings, sites, objects, or districts that possess exceptional value or quality in illustrating or interpreting the historical (history and archaeology) heritage of our country are eligible for designation as National Historic Landmarks. Although National Historic Landmarks are predominately in private ownership, they often are of interest to visitors. Individual landmarks are open to the public through efforts of local governments, historical societies, private organizations, and others. In addition, some historic sites are public buildings (such as churches, banks, courthouses, and commercial buildings).

All of the National Historic Landmarks are automatically included on the National Register of Historic Places. In addition, there are other historic sites which have been included on the National Register, but which have not been designated as National Historic Landmarks (Atlas plate 31 - 40). These are also popular tourist attractions and sightseeing destinations.

Within the coastal regions of South Carolina and Georgia there are numerous natural areas of scenic beauty which provide sightseeing opportunities. Many of these have been designated as actual or potential National Natural Landmarks. The National Natural Landmark Program, administered through the National Park

Service, encourages the preservation of sites that illustrate the geological and ecological character of the United States.

CHAPTER THREE

DEMOGRAPHIC, ECONOMIC, AND SOCIAL CHANGES

I. INTRODUCTION

The 14 counties designated as the Sea Island Coastal Region have a land area of approximately 9,340 mi^2 (24,190.6 km^2). In 1976, this area was estimated to have a population of about 827,700 (Table 3-1) or 10.6% of the total population for South Carolina and Georgia. Coastal economic data reflect significant changes that are taking place in the Sea Island Coastal Region. Also, these data suggest that the region has sufficient unused human resources to provide a basis for substantial economic growth.

The Sea Island Coastal Region has an economically advantageous geographic setting. It is located in and between three Standard Metropolitan Statistical Areas (SMSA): Charleston, South Carolina; Savannah, Georgia; and Jacksonville, Florida. The major connecting arteries for these three centers are Interstate Highway 95, which traverses the length of the region and is a major tourist route to Florida from the Northeast, and the Seaboard Coast Line railroad. The Intracoastal Waterway runs the entire

Table 3-1. Percent population and growth in the Sea Island Coastal Region (Akioka 1978, South Carolina Budget and Control Board 1978).

County	1960 Number	1970 Number	1976 Number	1976 Percent Coastal Zone Population	1976[a] Percent State Population	Percent Change In Population 1970-1976
Georgetown	34,798	33,500	38,200	7.3	1.3	8.9
Berkeley	38,196	56,199	74,800	14.2	2.7	48.9
Dorchester	24,383	32,276	46,700	8.9	1.6	47.8
Charleston	216,382	247,650	263,000	50.0	9.2	17.7
Colleton	27,816	27,622	29,500	5.6	1.0	5.7
Beaufort	44,187	51,136	60,100	11.4	2.1	26.5
Jasper	12,237	11,885	13,200	2.5	0.5	7.3
S.C. Coastal Zone[b]	397,999	460,268	525,500	100.0	18.5	28.0
S. Carolina	2,382,594	2,590,516	2,844,000	---	---	16.2
Effingham	10,144	13,632	15,800	5.2	0.3	35.8
Chatham	188,299	187,767	186,400	61.7	3.7	- 1.0
Bryan	6,226	6,539	8,300	2.7	0.2	24.9
Liberty	14,487	17,569	23,400	7.7	0.5	38.0
McIntosh	6,364	7,371	8,200	2.7	0.2	22.4
Glynn	41,954	50,528	47,900	15.9	0.9	12.4
Camden	9,974	11,334	12,200	4.0	0.2	18.2
Georgia Coastal Zone	277,448	294,740	302,200	100.0	6.0	8.2
Georgia	3,943,116	4,589,575	4,984,000	---	---	20.0

a. Provisional data.
b. South Carolina coastal zone excluding Horry County which was excluded in the study area.

length of the region's coastline. (See Chapter Six for description of transportation systems of the study area.)

Principal economic activities within the Sea Island Coastal Region are pulp and paper production, fertilizer manufacturing, food processing, agriculture, forestry, fisheries, recreation and tourism, and government. The major cities are Charleston, Savannah, and Brunswick, which have strong economic bases because of diversification and seaport activities. The ports of Charleston and Savannah are two of the largest on the east coast and maintain an interior trade area deep into the middle United States.

The economy of the region in the last 50 years has not changed as drastically as in other areas of the South, partly because the area has not recently been heavily dependent on agriculture. Consequently, there has not been a dramatic shift from one economic base to another. Several areas of the economy have experienced a surge, however, causing an influx and need for more labor, e.g., tourism, light industry, and expansion of pulp and paper and naval store-oriented industries.

Portions of the region that have shown the most solid economic growth are those parts which have blended the coastal economy with the hinterland economy. These areas are found in Charleston, Chatham, and Glynn counties. The rest of the region has exhibited slower economic growth.

This chapter presents historical data on demography, economics, and social development of the Sea Island Coastal Region. Major emphasis has been placed on regional growth trends, since these are pertinent to environmental impact analysis. Where possible, data have been collected and presented in a useful form for present and future environmental impact analysis. Data on such items as income and employment are provided on a basis relative to U.S. levels (e.g., per capita income) or U.S. growth rates.

Much of the data used in this chapter was collected during the 1970 census. These data, although limited in scope, reflect changes and trends occurring within this time frame and over the past several decades in the Sea Island Coastal Region. More recent information in the form of estimates and provisional data was used where possible. In many cases, comparable data for South Carolina and Georgia were not available. Thus, each geographic area of the study region is treated individually according to availability of data. A general overview of population characteristics of the study area is presented in the first section of this chapter. This is followed by an areawide economic analysis of the coastal area for both States. The treatment for South Carolina is separate from that of Georgia because of discrepancies in data availability.

A great deal of information in this chapter was obtained from Akioka (1978) and the South Carolina Budget and Control Board (1978). Also, the Coastal Area Planning and Development Commission (1975) provided information on areawide economic base and population studies for the Georgia counties. In South Carolina, the Waccamaw Regional Planning and Development Council; the Berkeley, Charleston, and Dorechester Regional Planning Council; the Lowcountry Council of Governments; and the South Carolina Coastal Council provided up-to-date economic and demographic data.

II. DEMOGRAPHIC CHARACTERISTICS OF SEA ISLAND COASTAL REGION

A. POPULATION SIZE AND GROWTH

The Sea Island Coastal Region contains approximately 10.6% of the total population of South Carolina and Georgia (Table 3-1), based on 1976 population estimates. In comparison, the population for this region was 10.7% of the two-State total during 1960. This would indicate that the Sea Island Coastal Region has experienced a population growth in similar proportion to the entire two-State area over the 17-year period.

In 1960, the population of the South Carolina coastal region was 16.7% of the total population of the State, but by 1976, the area's share of the State population had increased to 18.5%. Most of this increase took place in the Charleston SMSA, which is comprised of Charleston, Berkeley, and Dorchester counties (Table 3-1). In 1975, the Charleston SMSA had a slightly larger population than the mid-State Columbia SMSA, but a substantially smaller population than the Greenville-Spartanburg SMSA, located in the northwestern part of the State. The Charleston SMSA ranked 97th among the nation's 159 "large" Standard Metropolitan Statistical Areas (populations of 200,000 or more) listed by the U.S. Department of Commerce, Bureau of the Census (1977a).

As shown in Table 3-1, the population of Charleston County itself increased very little compared to Berkeley and Dorchester counties, which showed increases of 48.9% and 47.8%, respectively, for the 17-year period. These two counties have emerged as possibly the most influential employment center in the region, accounting for the population increases. The opening of Interstate Highway I-26, the extension of utility systems, the lower price of land, and the outward flow of jobs have contributed greatly to making Berkeley and Dorchester counties the fastest growing areas of the Sea Island Coastal Region.

Population of the Georgia coastal area has not increased in proportion with the remainder of the State. In 1960, population in the seven coastal counties comprised approximately 7% of the State's total population, while in 1976 it only represented about 6% (Table 3-1). Major population concentrations occur in Chatham, Glynn, and Liberty counties in and around the cities of Savannah, Brunswick, and Hinesville. The other five counties predominantly have a dispersed population. Because of population concentrations at Savannah and Brunswick, Chatham and Glynn counties are nearly three-fourths urban.

The greatest percentage increases in population on the Georgia coast have been in Liberty, Effingham, and Bryan counties (Table 3-1). During 1960-1976, Liberty County had a 38% change in population. This was due primarily to growth in the City of Hinesville. The main impetus for this growth is the activation of Ft. Stewart as a military training base, resulting in increases both in base personnel and civilian employment (Coastal Area Planning and Development Commission 1975). Effingham County has sustained a constant growth (36%) because of its geographical location and accessibility. Bryan County (25% growth increase) in the past has been a rural community. However, with declining agriculture and an improved highway system, the county has opened up to increased development and is a bedroom community to the expanding Savannah metropolitan area. Increased growth of Camden County is also anticipated due to the development of Kings Bay as a Trident Submarine Base.

Variation in population density within the Sea Island Coastal Region as a whole is significant when comparisons are made by county. Variations range from a low of 15 people per square mile in Bryan County to a high of 422 persons per square mile in Chatham County (Table 3-2). The tendency of the population to cluster around major harbors is evident. Also, environmental problems associated with population growth and, to some extent, industrial growth are likely to be concentrated in those counties of highest population density.

B. URBAN AND RURAL POPULATION TRENDS

Population diversity among coastal counties is also reflected by the degree of urbanization within each county. Urban residents, as defined by the Bureau of the Census, are persons living in incorporated or unincorporated places of 2,500 or more inhabitants.

As Table 3-3 indicates, the most populous counties (Chatham and Charleston) are also the most urbanized with 88.9% and 81.8% of their population urban, respectively. At the other extreme, in the least populous counties (Jasper, McIntosh, and Bryan), 100% of the population resides in rural areas.

All coastal counties in the characterization area increased their degrees of urbanization from 1960 to 1970, except Chatham County where the City of Savannah is located. Chatham County has not only declined in total urban population but also in total population. This decline of population concentration in the larger cities is consistent with national trends toward suburbanization as both businesses and residents seek less congested environments to carry out their activities.

C. RACIAL POPULATION TRENDS

One of the indicators of future economic development and employment is the percentage of non-whites in the population. During the last decade, changes have taken place in racial composition in many coastal counties of the study area. The non-white population declined while the white population increased rapidly from 1960 to 1970 (Table 3-4). The decline in non-white population in the area may indicate a lack of employment opportunities for minorities. Thus, non-white emigration from the area may have occurred.

The white population in Berkeley, Dorchester, and Effingham counties experienced large increases over the same period. The white population of Berkeley County had a growth of 103.0%, Dorchester County increased by 66.4% and Effingham County had 54.7% white population increase.

According to estimates published in the South Carolina Statistical Abstract (South Carolina Budget and Control Board 1978), in 1977 the white population in the coastal area comprised 64% of the total coastal population. The county with the largest percentage of non-white residents is Charleston.

According to the Georgia Statistical Abstract (Akioka 1978), in 1970 on a regional scale, the white population comprised 67.4% of the total coastal population. The county with the largest percentage of non-white residents is McIntosh, although the largest concentration of non-whites is in Chatham County.

D. PROJECTIONS OF POPULATION

Characteristics of the future popula-

Table 3-2. Density of population of the coastal counties of South Carolina and Georgia, 1960 and 1970 (Akioka 1978, South Carolina Budget and Control Board 1978).

Item	South Carolina Coastal Counties							
	Beaufort	Berkeley	Charleston	Colleton	Dorchester	Georgetown	Horry	Jasper
Density of Population - Persons Per Square Mile								
1960	75	35	229	27	43	43	59	19
1970	88	51	264	26	57	41	61	18

Item	Georgia Coastal Counties						
	Bryan	Camden	Chatham	Effingham	Glynn	Liberty	McIntosh
Density of Population - Persons Per Square Mile							
1960	14	15	427	21	99	28	15
1970	15	17	422	28	123	34	17

Table 3-3. Population trends by urban and rural areas in the coastal counties of South Carolina and Georgia, 1960 and 1970 (Akioka 1978, South Carolina Budget and Control Board 1978).

ITEM	SOUTH CAROLINA COASTAL COUNTIES															
	Beaufort		Berkeley		Charleston		Colleton		Dorchester		Georgetown		Horry		Jasper	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
1960 Population by Residence																
Total Urban	6,298	14.2	6,111	16.0	159,188	73.5	5,417	19.5	3,633	14.9	15,201	43.7	16,397	24.0	-----	-----
Total Rural	37,889	85.8	32,085	84.0	57,264	26.5	22,399	80.5	20,750	85.1	19,597	56.3	51,850	76.0	12,237	100.0
Total Population	44,187	100.0	38,196	100.0	216,382	100.0	27,816	100.0	24,381	100.0	34,781	100.0	68,247	100.0	12,237	100.0
1970 Population by Residence																
Total Urban	25,657	50.2	25,745	45.8	202,654	81.8	6,257	22.6	3,839	11.9	13,280	39.6	20,551	29.4	-----	-----
Total Rural	25,479	49.8	30,454	54.2	44,996	18.2	21,365	77.4	28,437	88.1	20,220	60.4	49,441	70.6	11,885	100.0
Total Population	51,136	100.0	56,199	100.0	247,650	100.0	27,622	100.0	32,276	100.0	33,500	100.0	69,992	100.0	11,885	100.0
Change 1960-1970																
Total Urban	19,359	307.3	19,634	321.3	43,536	27.4	840	15.5	206	5.6	-1,921	-12.6	4,154	25.3	-----	-----
Total Rural	-12,410	-32.7	-1,631	-5.1	-12,268	-21.4	-1,034	-4.6	7,687	37.0	623	3.7	-2,409	-4.6	-252	-2.0
Total Population	6,949	15.7	18,003	47.1	31,268	14.5	-194	-.7	7,893	32.3	-1,298	-3.7	1,745	2.5	-252	-2.0

ITEM	GEORGIA COASTAL COUNTIES													
	Bryan		Camden		Chatham		Effingham		Glynn		Liberty		McIntosh	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
1960 Population by Residence														
Total Urban	-----	-----	3,272	32.8	169,887	90.3	-----	-----	30,319	72.2	3,174	21.9	-----	-----
Total Rural	6,226	100.0	6,703	67.2	18,412	9.7	10,144	100.0	11,635	27.8	11,313	78.1	6,364	100.0
Total Population	6,226	100.0	9,975	100.0	188,219	100.0	10,144	100.0	41,954	100.0	14,487	100.0	6,364	100.0
1970 Population by Residence														
Total Urban	-----	-----	3,408	30.0	167,037	88.9	-----	-----	33,498	66.3	8,582	48.9	-----	-----
Total Rural	6,539	100.0	7,926	70.0	20,730	11.1	13,632	100.0	17,030	33.7	8,986	51.1	7,371	100.0
Total Population	6,539	100.0	11,334	100.0	187,767	100.0	13,632	100.0	50,528	100.0	17,569	100.0	7,371	100.0
Change 1960-1970														
Total Urban	-----	-----	136	4.1	-2,850	-1.6	-----	-----	3,179	10.4	5,408	170.3	-----	-----
Total Rural	313	5.0	1,222	18.2	2,318	12.5	3,488	34.3	5,395	46.3	-2,327	-20.5	1,007	15.8
Total Population	313	5.0	1,359	13.6	-452	-2.4	3,488	34.3	8,583	20.4	3,082	21.2	1,007	15.8

Table 3-4. Racial characteristics of the coastal counties of South Carolina and Georgia, 1960 and 1970 (Akioka 1978, South Carolina Budget and Control Board 1978).

ITEM	South Carolina Coastal Counties							
	Beaufort	Berkeley	Charleston	Colleton	Dorchester	Georgetown	Horry	Jasper
1960 Population								
White	27,083	19,233	137,449	13,589	12,480	16,652	50,005	4,619
Non-White	17,104	18,963	78,933	14,227	11,903	18,146	18,242	7,618
1970 Population								
White	33,864	39,044	168,414	14,597	20,778	17,258	52,471	5,095
Non-White	17,272	17,155	79,236	13,025	11,498	16,242	17,521	6,790
% Change 1960-1970								
White	25.0	103.0	22.5	7.4	66.4	3.6	4.9	10.3
Non-White	0.9	-9.5	0.4	-8.4	-3.4	-10.5	-3.9	-10.8

ITEM	Georgia Coastal Counties						
	Bryan	Camden	Chatham	Effingham	Glynn	Liberty	McIntosh
1960 Population							
White	3,927	5,951	124,116	6,643	30,306	8,348	2,674
Non-White	2,299	4,024	64,183	3,501	11,648	6,139	3,610
1970 Population							
White	4,742	7,221	123,295	10,280	37,816	9,628	3,677
Non-White	1,797	4,113	64,472	3,352	13,712	7,941	3,694
% Change 1960-1970							
White	20.7	21.3	0.6	54.7	24.7	15.3	37.5
Non-White	-21.8	2.2	0.4	-4.2	9.1	29.3	0.1

tion of the Sea Island Coastal Region are difficult to predict. Obviously, future growth or contraction largely depends on changes in the economy. The regional economy appears to be strengthening, becoming more diverse and nationally oriented, and moving people to a higher level of prosperity. The economic future is, however, dependent on decisions that are yet to be made.

If regional and national trends continue with no major changes, the population of Sea Island Coastal Region would increase significantly (Table 3-5). Figures used in these projections were taken from the 1970 census, which is the latest information available for certain counties. These data may be misleading since some areas, such as the Charleston SMSA, have grown at a much faster rate than projected in 1970. The census data projected a population for Charleston SMSA of 383,300 by the year 2020. However, Regional Indicators projects a total population of one half million by 1995 (Berkeley - Charleston - Dorchester Council of Governments 1978).

The most extensive development in the South Carolina Sea Island Coastal Region is expected to occur in three broadly defined areas radiating from the Charleston peninsula. These are the Mt. Pleasant division to the east, the James Island and Johns Island areas to the west - including the resort developments of Kiawah and Seabrook islands - and, finally, the fastest growing population complex in the region, the North Charleston-Lower Berkeley County-Summerville area.

In Georgia, population projections made in 1970 are also misleading, i.e., the Savannah SMSA, like the Charleston SMSA, is growing at a much faster rate than projected in Table 3-5. According to the Coastal Area Planning and Development Commission (1975), the Savannah SMSA population is projected to be around 250,000 by 1995. County officials have indicated that these figures are probably low. Chatham and Glynn counties are expected to sustain constant growth because of expanded economic activities due to offshore oil and gas exploration and development activities.

III. ECONOMIC CHARACTERISTICS OF SEA ISLAND COASTAL REGION

A. SOUTH CAROLINA

The South Carolina Sea Island Coastal Region is characterized by very uneven distribution of population and employment opportunities. In 1975, Jasper, Beaufort, Charleston, Georgetown, and Horry counties had 73% of the area's total population.

For simplicity's sake, much of the discussion which follows deals with South Carolina's coastal area in terms of three broad regions: the Low Country (Jasper, Beaufort, and Colleton counties), the Greater Charleston Area (Berkeley, Charleston, and Dorchester counties), and the Waccamaw region (Georgetown and Horry counties). Horry County is not defined in the Sea Island Coastal Region for the characterization. However, it is included in these analyses because of its strong influence on the area's economic structure.

1. Income Distribution

Income produced in South Carolina's coastal counties in 1975 was $2.14 billion, which was 21.4% of the total produced in the State. The percentage increase from 1970 to 1975 (not adjusted for inflation) was somewhat higher for the coast (61.7%) than for the State (56.2%) or the Nation (55.0%). Although these figures are in part a reflection of the relatively low levels of development in the coastal area prior to 1970, they demonstrate that the coastal economy is healthy (Table 3-6).

The State average per capita income was 84.5% of the national average of $5,460 reported by the U.S. Department of Commerce, Bureau of Economic Analysis (1975a), and the ratio for the coast was approximately the same (Table 3-7). For the various counties, the per capita incomes in 1976 were the following percentage of the U.S. average (U.S. Department of Commerce, Bureau of the Census 1977a):

Low Country:	Beaufort	118.7%
	Colleton	66.3%
	Jasper	58.4%
Greater Charleston:	Berkeley	68.0%
	Charleston	90.1%
	Dorchester	76.7%
Waccamaw:	Georgetown	75.1%
	Horry	85.0%

When a large proportion of the total income goes to a relatively small percentage of the total population, the average income per person or per family is a poor indication of the welfare of most of the people. A much better indicator is the median family income, the amount which is midway between the lowest and highest incomes in the county. In 1969 (the most recent year for which such data are available), Beaufort County, with the highest average income per capita in the State, ranked only 4th among the eight coastal counties and 26th among the State's 46 counties in median family income. For median family incomes of black families, Beaufort County ranked 36th in the State and 4th in the coastal

Table 3-5. Projections for total population in coastal counties of South Carolina and Georgia in 1980, 2000, and 2020 (U.S. Department of Commerce, Bureau of Economic Analysis 1975a, b).

Area	Number			Percent Change		
	1980	2000	2020	1980-2000	2000-2020	1980-2020
Charleston (SMSA)[a]	316,200	350,500	383,300	10.8	9.4	21.2
Beaufort	50,400	52,500	55,400	4.2	5.5	9.9
Colleton	25,900	28,500	31,200	10.0	9.5	20.5
Georgetown	38,600	43,400	44,900	12.4	3.5	16.3
Horry	78,000	87,200	91,900	11.8	5.4	17.8
Jasper	12,700	12,100	11,200	-4.7	-7.4	-11.8
South Carolina (State Total)	2,818,500	3,319,400	3,666,700	17.8	10.5	30.1
Savannah (SMSA)[b]	203,000	221,600	230,600	9.2	4.1	13.6
Camden	11,900	13,300	13,900	11.8	4.5	16.8
Glynn	57,300	69,900	77,300	22.0	10.6	34.9
Liberty	19,500	19,900	20,300	2.1	2.0	4.1
McIntosh	8,700	10,300	11,300	18.4	9.7	29.8
Georgia (State Total)	5,167,300	6,458,100	7,491,100	25.0	16.0	45.0

a. Charleston (SMSA) contains Charleston, Berkeley, and Dorchester counties.

b. Savannah (SMSA) contains Bryan, Effingham, and Chatham counties.

Table 3-6. Labor and proprietors' income (in thousands of dollars) by category for three economic areas of the South Carolina coastal region, 1975[a] (U.S. Department of Commerce, Bureau of Economic Analysis, 1975, unpubl. data).

Category	Low Country		Greater Charleston		Waccamaw		Entire Coastal Area		State	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount (Millions)	Percent
Farm	11,587	3.2	12,843	0.9	46,892	11.3	71,322	3.3	325.6	3.2
Manufacturing	29,024	8.1	167,214	12.2	95,767	23.1	292,005	13.6	3,193.8	31.9
Construction	15,950	4.4	90,655	6.6	19,877[b]	4.8	126,482[b]	5.9	634.4	6.3
Mining	-------	-------	-------	-------	-------	-------	-------	-------	20.1	0.2
Trade	31,826	8.8	193,576	14.2	65.757	15.8	291,159	13.6	1,424.0	14.2
Finance, Insurance & Real Estate	21,600	6.0	46,913[c]	3.4	12,707	3.1	78,220[c]	3.7	401.2	4.0
Transportation, Communication, and Public Utilities	9,406	2.6	76,995	5.6	12,058	2.9	98,459	4.6	510.7	5.1
Services	36,688	10.2	168,739	12.4	66,280	16.0	271,707	12.7	1,211.5	12.1
Other Industries	-------	-------	-------	-------	7,749	1.9	-------	-------	33.2	0.3
Government	199,881	55.5	601,599	44.0	85,262	20.5	886,742	41.4	2,271.1	22.6
Federal Civilian	23,656	6.6	241,537	17.7	11,195	2.7	276,388	12.9	461.7	4.6
Federal Military	49,480	41.5	204,378	15.0	36,359	8.7	390,217	18.2	696.1	6.9
State & Local	26,745	7.4	155,684	11.4	37,708	9.1	220,137	10.3	1,113.3	11.1
Total	$359,981		$1,365,902		$415,299		$2,141,182		$10,025.7	
Federal %		48.1		32.7		11.4		31.1		11.5

[a] Reported by place of work.

[b] Includes $2.4 million allocated to Georgetown.

[c] Includes $2.0 million allocated to Berkeley and Dorchester counties.

Table 3-7. Personal income[a] (in thousands of dollars) of residents of South Carolina coastal region, by economic area and major source of income, 1975 (U.S. Department of Commerce, Bureau of Economic Analysis, 1975, unpubl. data).

Category	Low Country		Greater Charleston		Waccamaw		Entire Coastal Area		State	
	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount (Millions)	Percent
Labor & Proprietors	361,108	73.8	1,299,387	75.6	391,568	71.2	2,052,063	74.4	$ 9,622.4	74.0
Dividends, Interest & Rent	63,350	13.0	182,560	10.6	75,788	13.8	321,698	11.7	1,502.5	11.5
Transfer Payments	64,657	13.2	236,385	13.8	82,693	15.0	383,735	13.9	1,881.4	14.5
Total	489,115	100.0	1,718,332	100.0	550,049	100.0	2,757,496	100.0	13,006.3	100.0
Population Number	94,700		371,600		122,900		589,200		2,818,210	
Income Per Capita	$ 5,165		$ 4,624		$ 4,476		$ 4,680		$ 4,615	
Percent of U.S.		94.6		84.7		82.0		85.7		84.5

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[a] Reported by county of residence.

area. Thus, it is apparent that Beaufort County's unusually high per capita income is concentrated within a small segment of the population and cannot be viewed as typical.

A comparison of the income data in Table 3-6 with the employment data in Table 3-8 reveals that in the coastal area, incomes per worker are much higher in government work than in the private sector of the economy. The relative importance of government as a source of income is probably due to the large proportion of Federal, as opposed to State or local, employees. It also is a reflection of the seasonal and/or irregular nature of many recreation and tourism-related jobs. A third factor contributing to the relative importance of government employment is the low wage rate of many jobs in the private sector of the coast.

Except for the government-related distortion discussed above, industry groups on the coast are similar in importance as employment and income sources. One major exception is wholesale and retail trade, which is less important as a source of income than as a source of employment. Presumably, this reflects the low wage structure of retail trade and the seasonality of some coastal enterprises.

The employment and income data presented in Tables 3-6 and 3-8 are based on the worker's place of employment, rather than place of residence. Such data may be a poor indication of the income and welfare of the residents of a particular county or area. This is true because workers commute across county lines to work, and because personal income includes income from capital and land (dividends, interest, and rent) and "transfer payments" such as pensions, annuities (including Social Security) and welfare payments.

2. Employment Trends

a. Employment. Any discussion of the economy of the coastal region must include an awareness of the economy of the State as a whole, as well as the national economy. South Carolina was identified as one of six States most sensitive to national economic developments by the Bureau of Economic Analysis. This means that swings of the business cycle are larger in the State and the coastal area than elsewhere (U.S. Department of Commerce, Bureau of Economic Analysis 1979).

Data on population, labor force, employment, and unemployment in the coastal area are given in Table 3-9. These data, unlike the employment data in Tables 3-6 and 3-8, are based on county of residence rather than place of work, and agricultural workers, self-employed, unpaid family, and domestic workers are included. The data in Table 3-9, therefore, are not strictly comparable with the data in Table 3-8.

The coastal area had 21.2% of the establishments, 15.3% of the employees (in the week of March 12) and 14.3% of the payrolls of those industries covered by a survey conducted in 1974 (Table 3-10). The average number of employees per establishment was considerably lower in the coastal area than in the State as a whole, and only one county (Georgetown, with an average of 15.2 employees/establishment) was even close to the State average of 16.5. The coastal area, therefore, is characterized by a number of small business establishments rather than by larger industrial centers.

b. Unemployment. The rate of unemployment for the State in 1975 was 8.7% (Table 3-9) as compared with 4.1% in 1973 and 5.9% in 1974. Thirteen of the State's 46 counties had over 11% of their labor force unemployed and in three, the rate of unemployment in 1976 was above 15%. In contrast, only two of the eight coastal counties had above 10% unemployment in 1975, and for the coastal zone as a whole, the rate was only 7.9%.

The relative impact of the recession was apparently less in the coastal area than in the rest of the State. Recent data from the Division of Research and Statistical Services indicate that the State unemployment rate of 4.7% in December 1977 was the lowest since December of 1973 (South Carolina Budget and Control Board 1978). A downward trend in unemployment in South Carolina (which presumably would affect the coast) may be underway, since the adjusted rate for 1977 was 5.4%, down from 6.9% in 1976 (South Carolina Budget and Control Board 1977).

c. Employment Projections. South Carolina's economy has maintained a steady recovery rate since the 1974 recession, and the growth rate has been above that of the South Atlantic Region. According to the South Carolina State Budget and Control Board, "this trend is expected to continue for the next four years as South Carolina narrows the gap between the region and the nation in jobs and especially in incomes" (South Carolina Budget and Control Board 1976).

Projections on future employment for South Carolina coastal counties show that counties mentioned, except Jasper, will have increased employment during the next several decades (Table 3-11). Jasper County, because of the projected loss in population, shows an employment

Table 3-8. Average annual nonfarm wage and salary employment[a], South Carolina coastal region, 1975 (South Carolina Budget and Control Board 1976).

Category	Low Country		Greater Charleston		Waccamaw		Coastal Region		State	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Manufacturing	3,920	16.4	14,300	12.5	10,320	25.7	28,540	16.0	336,300	34.0
Contract Construction	1,730	7.3	9,000	7.9	2,220	5.5	12,950	7.3	61,800	6.0
Transportation, communication, and public utilities	810	3.4	6,700	5.8	1,100	2.7	8,610	4.8	40,300	4.0
Wholesale and Retail Trade	4,290	18.0	24,400	21.3	9,030	22.4	37,720	21.1	175,600	18.0
Finance, Insurance and Real Estate	1,890	7.9	4,900	4.3	1,470	3.7	8,260	4.6	39,100	4.0
Service and Miscellaneous	4,200	17.6	16,100	14.1	9,290	23.1	29,590	16.6	124,600	12.0
Government[b]	7,010	29.4	39,100	34.1	6,790	16.9	52,900	29.6	200,100	20.0
Total	23,850	100.0	114,500	100.0	40,220	100.0	178,570	100.0	977,800	100.0

a. Employment reported by place of work.

b. Excluding non-civilian military personnel.

Table 3-9. Estimated average annual labor force, employment, and unemployment in South Carolina coastal counties, 1975[a] (South Carolina Budget and Control Board 1976).

County	Population	Civilian Labor Force		Number Employed	Number Unemployed	Unemployed Percent
		Number	% of Pop.			
Beaufort	53,100	18,050	34.0	16,640	1,410	7.8
Berkeley	64,400	21,700	33.7	19,700	2,000	9.2
Charleston	262,900	91,000	34.6	84,500	6,500	7.1
Colleton	28,700	11,100	38.7	10,080	1,020	9.2
Dorchester	44,300	14,600	33.0	13,500	1,100	7.5
Georgetown	37,800	15,180	40.2	13,540	1,640	10.8
Horry	85,100	41,300	48.5	38,200	3,100	7.5
Jasper	12,900	4,970	38.5	4,450	520	10.5
Total	589,200	217,900	37.0	200,610	17,290	7.9
State Total	2,818,000	1,180,000	41.9	1,077,000	103,000	8.7

a. Reported by place of residence. Total employment includes agricultural workers and non-agricultural self-employed, unpaid family, and domestic workers.

Table 3-10. Number of establishments and employees, and amount of payrolls, South Carolina coastal counties, 1974[a] (U.S. Department of Commerce, Bureau of the Census 1976a).

Economic Area	Number of Establishments	Employees Week of March 12, 1974 Number	Employees Week of March 12, 1974 Per Establishment	Annual Payroll, 1974 Total ($1000's)	Annual Payroll, 1974 Per Worker (Dollars)
Low Country	1,568	17,172	11.0	107,775	6,276
Greater Charleston	5,966	76,207	12.8	533,528	7,001
Waccamaw	2,746	28,887	10.5	197,925	6,852
Coastal Zone	10,280	122,266	11.9	839,228	6,864
State	48,743	799,046	16.5	5,863,565	7,338

a. Does not include: Self-employed persons, agriculture and domestic service, government and railroads.

Table 3-11. Employment projections for South Carolina coastal region, 1980 - 2020 (U.S. Department of Commerce, Bureau of Economic Analysis 1975a).

Area	1980	1990	2000	2010	2020
Beaufort	26,200	27,100	28,300	28,600	29,800
Charleston (SMSA[a])	14,500	15,900	17,000	17,800	17,600
Colleton	131,500	140,900	150,800	160,500	164,500
Georgetown	9,800	10,600	11,100	11,800	12,200
Jasper	4,500	4,600	4,600	4,600	4,400

a. SMSA - area includes Charleston, Berkeley, and Dorchester counties.

decrease by the year 2020.

3. Major Business Activities

a. Agriculture. A 1967 land use survey identified 11.0% of the land in the coastal region as cropland and 2.5% as pasture (Hart 1968). Corresponding figures for the State as a whole were 20.0% and 5.4% respectively, indicating that agriculture is of relatively less importance in the coastal area than in the State as a whole. In 1975, however, agriculture provided 3.3% of the total labor and proprietors' income in the Sea Island Coastal Region (Table 3-6), while farm income for the State as a whole was 3.2% of the total. The high coastal figure was due primarily to the Waccamaw area, which derived 11.3% of its income from farm sources. The Low Country area obtained 3.2% of its income from agriculture, while the figure for the Greater Charleston region was only 0.9%.

These percentages are likely to increase in the future. In the 15 December 1976 report to the State Budget and Control Board, the South Carolina Division of Research and Statistical Services noted that "with or without a farmers' strike, the long term trend of the incline in prices will keep pace with increases in the prices of other consumer goods and services" (South Carolina Division of Research and Statistical Services 1976).

The Low Country coastal area accounted for 22.5% of the cash receipts from marketing crops by South Carolina farmers in 1975, a share which is almost exactly the same as the coastal area's 22.7% share of the total land area of the State. The State's most valuable crop, tobacco, was also the coastal region's most valuable crop, with Horry County ranking first among all the counties of the State in tobacco sales. The farmers of the coastal area marketed only 11.2% of the State's second most valuable crop, soybeans, and 20.7% of the corn crop, which ranked third in both the coastal area and the State. In terms of cash value, soybeans (produced mostly in Charleston and Beaufort counties) were second only to the tobacco profits of the northern coastal region.

The farmers of the coastal area marketed 25.0% of the hogs and 10.2% of the cattle sold by South Carolinians in 1975. In all, the coastal share of crops and livestock was 18.3% of the State total (Clemson University 1975).

b. Coastal Fisheries. All commercial fish landings in South Carolina occur within the coastal counties. The total value of the 1976 catch was $14,069,569 and is broken down as follows:

	VOLUME (LB)	VALUE ($)
Shrimp (heads on)	8,053,006	$11,043,381
Blue Crabs, hard	5,739,936	975,847
Clams, hard (meats)	172,464	208,686
Oysters (meats)	1,187,077	759,063
Squid	12,454	3,311
All finfish	5,713,661	1,079,281

The shrimp fishery is by far the most important commercial fishery in the State. It accounted for 41% of the volume and 78% of the ex-vessel value of all catches over the years 1974, 1975, and 1976. In descending order of importance, shrimp is followed by finfish, blue crab, and oyster-clam fisheries.

Most South Carolina-caught seafood is shipped out of the State. In 1976, only 6% to 8% of the total shrimp harvest was sold at dockside, while South Carolina retailers, chain stores, and restaurants each received less than 5% of the harvest (Theiling 1978).

The numerous recreational fishery resources of the coastal waters, including the nationally famous freshwater striped bass fishery of the Santee-Cooper lakes, are of high quality and are used heavily. In 1977, they included 13 ocean fishing piers, 60 boat ramps, 33 marinas, 4 boat rental businesses, 9 artificial fishing reefs, 49 charter boats (which usually carry four to six people each), and 19 "head boats" (which can carry up to 118 anglers each). Recreational crabbing and shrimping are popular as is the recreational harvesting of oysters and clams (Cupka 1977). (Refer to Chapter Seven for a description of the seafood industry.)

c. Forestry. As of 1967, 62.8% of the coastal area was forested land (Table 3-12). The Waccamaw region had by far the most forested land, with 72.0% of its total area falling into this category. The Greater Charleston region had only 55.3% forested land, while the Low Country had 63.4% forested land. Presumably, the amount of forested land is lower now because of increased industrial and residential development. Much of the Federally owned land in South Carolina is forested land that was not inventoried, however, making the actual totals higher than they appear to be.

Although large, the quantity of forest along the coast is only 19.2% of the total forested land of the State, based on 1975 figures. However, the income derived from coastal forests is 26.7% of the State's forest-derived income, indicating that silviculture plays a somewhat more important role in the economy

Table 3-12. Land use (thousands of acres) for South Carolina coastal counties (U.S. Department of Agriculture, Soil Conservation Service 1970).

County	Total Land Area[a]	Not Inventoried		Inventories by Soil Conservation Service			
		Federal	Other[b]	Cropland	Pasture	Forest	Other
Beaufort	385.0	13.8	20.8	44.4	10.0	153.0	130.0
Berkeley	708.7	201.0	32.5	50.6	13.0	386.2	20.7
Charleston	665.1	101.0	49.2	42.8	18.9	260.0	133.3
Colleton	686.0	0.0	29.9	103.3	28.0	482.3	27.5
Dorchester	367.5	0.0	6.3	56.2	8.5	278.8	14.2
Georgetown	556.8	0.0	22.6	28.7	6.2	419.5	42.9
Horry	751.1	3.6	42.4	159.8	15.5	485.3	29.4
Jasper	431.7	6.6	14.2	36.2	12.0	297.8	61.2
Total	4,551.9	326.0	217.9	522.0	112.1	2,762.9	459.2
State Total	19,338.3	1,042.7	1,141.2	3,865.4	1,037.7	11,427.1	824.3

a. Excludes water areas larger than 40 acres and rivers wider than one-eighth mile.

b. Urban and built-up areas, and small water areas.

of the coastal area than it does in some other areas of the State.

Coastal forests produced 17.0% of the physical volume (cords) of pulpwood and 30.1% of the physical volume (board feet) of other forest products produced in South Carolina in 1975. The delivered value of these products was $52.1 million, or 26.7% of the value for the whole State (Clemson University 1975).

d. Industry and Government. Employment in the six major industries plus government was 178,570 for the coastal area during 1975 (Table 3-8). This figure is 18.3% of the total for the State. A relatively low level of manufacturing employment exists in all but the Waccamaw region. Georgetown, with 41.4% employed in manufacturing, was the only coastal county which exceeded the State percentage of manufacturing employees. It was also the only coastal county for which the average annual wage ($7,975 in 1974) was above the State's average.

A large percentage of the population is employed by government in the Low Country and Greater Charleston regions. Large public sector employment may be both an advantage and a liability to the economy of the coast. The coastal area withstood the rather severe 1975 recession better than other areas of the State, yet remains highly vulnerable to economic shocks from political decisions regarding the nature, level, and location of government expenditures - especially military expenditures.

B. GEORGIA

This section is based on information acquired in a 1975 areawide economic base and population study conducted by the Coastal Area Planning and Development Commission (CAPDC) in Brunswick, Georgia.

The Georgia Sea Island Coastal Region includes seven counties (Preface Fig. 2) and a land area of approximately 3,775 mi^2 (9,777.3 km^2). The Coastal Area Planning and Development Commission included Long County in their regional analysis. Therefore, an eighth county, Long County, is included in these analyses, even though it is not defined in the Sea Island Coastal Region. This region contained 74,031 families in 1970, of which 13,091, or 17.6% had incomes below the U.S. poverty level (Coastal Area Planning and Development Commission 1975).

The area has an economically advantageous geographic setting. It is located in and between two Standard Metropolitan Statistical Areas: Savannah, Georgia, and Jacksonville, Florida. The major highway, I-95, is also a major tourist route to Florida from the Northeast. The Intracoastal Waterway runs the entire length of the area's coastline. Finally, four major river systems draining a large portion of central Georgia terminate at the coast within the area.

The factors affecting the interior development and exterior relationships of Georgia's coastal area are homogeneous throughout. In effect, the south Georgia agriculture and timber economy has an even impact on the entire length of the coastal area. Coastal fisheries exist throughout the area, and the area's undeveloped resources, economic problems, and other factors appear relatively constant throughout the length of the region.

Chatham County has been a prime population center and trade area in coastal Georgia since 1733. Agriculture has declined almost to insignificance while residential, commercial, and industrial land uses have become dominant. Savannah has become and is expected to remain the regional center, having a trade area extending almost to Brunswick on the south and into South Carolina on the north. Port activities are a major business as are the pulp and paper industry. Tourism also is a prime activity, with numerous historical sites both in Savannah and surrounding counties. The median family income was higher than the State average, with high education levels as well. Prospects for continued economic growth of the county appear to be well-founded on the present stable and diversified economy.

Effingham County has recently experienced growth as residents move in from Chatham County. In the past, agriculture was the major occupation of the residents, but the life style is becoming more urban. Development is expected to spread northward towards Guyton and Springfield, leaving the rural nature of the northernmost portions of the county intact. Major businesses presently include textiles and forest products, although industrialization, with the exception of a Union Camp chip and saw mill, appears to be in the distant future. Population characteristics in 1975 were those of a rural county with below-average median family income and education levels, but a noticeable change should take place with the suburbanization of the county. Employment and population are projected to increase, although a major segment of the employees will be commuting into Chatham County. The increase in population will place greater demands on public facilities and utilities.

Bryan County has in the past been a rural, farming-oriented community. Declining agricultural interest and the improved highway system have opened the county to increased development as a bedroom community to the expanding Savannah metropolitan area. Additionally, Ft. Stewart, which divides the county into two distinct sections, recently underwent a personnel buildup that added development pressures to the western portion of the county. Family income, as a result, is expected to continue to rise at least to the State averages. Industrial employment is expected to increase around the nodes of Pembroke and Richmond Hill, as there are accessible and available industrial sites in these areas. Retail sales within the county are also expected to increase primarily as a function of the increased population. Major business activities will remain basically the same (e.g., wood products, tourism), with the possible exception of tourist shops along U.S. Route 17, which, with the opening of I-95, is undergoing conversion to serve military personnel.

Liberty County has the third largest population of the coastal counties. This is due in part to the presence of Ft. Stewart, which has just experienced a major buildup that may have increased the area's population by an additional 40,000, or more than twice the 1970 county population. The impact of such a rapid population increase has affected the Hinesville area with demands made on community facilities and utilities, particularly the housing market. The major activities within the county have been textiles, pulp and paper, retail sales, and services oriented to the military. Population characteristics in 1970 indicated the county's residents had above-average education levels but below-average median family income.

McIntosh County has in the past been a rural farming, fishing, and forestry oriented community. It is expected to lose much of its rural character as developmental pressures from Glynn County continue the trend of converting farmland to other uses. Population characteristics were similar to rural counties throughout the State with educational levels and median family incomes below the State average. Major business activities have evolved around the fishing industry and food processing, a plant producing footwear and other rubber products, and forest products. Employment and population are projected to increase with probable distribution around Darien, although some of the employees will be commuting to Glynn County to work.

Glynn County, with the City of Brunswick, has been the second most populous county in the coastal region for many years. Employment and population are projected to continue their upward climb. Industrial expansion is expected to take place along the waterfront and on Colonels Island, while commercial establishments are expected to consolidate in Brunswick and along the strip leading to the Brunswick Mall. Land use is expected to change somewhat as more of the county is developed. St. Simons and Jekyll islands will continue their roles as resort residential areas. Population characteristics showed education levels to be higher than State averages, but median family income to be less than the State average. Major business activities in the county consist of fishing, pulp and paper, retail and wholesale trade, tourism, and food processing. Brunswick is also expected to be impacted as a staging area for offshore energy exploration.

Camden County has for the past two decades been dependent on the pulp and paper industry. Agricultural employment has declined, following the trend of consolidation of farm lands into larger units. There has been little noticeable economic impact within the county as a result of completion of the southern portion of I-95. However, the linking of the county to the Jacksonville metropolitan area will eventually have a beneficial effect, if from nothing more than increased commuting to work in Jacksonville. Likewise, completion of the northern portion of I-95 to Brunswick will decrease the journey-to-work time, prompting further out-migration from Brunswick to Dover Bluff and other areas. Family income has been somewhat above the State average; however, per capita income was lower than the State average. In the future, a gradual increase in income is predicted, but the figures are so close to the present norms that this will not be a significant change. Retail sales have been increasing and are expected to continue the trend as population increases in the county. Competition from regional shopping centers in Brunswick, Jacksonville, and Waycross will probably discourage any major center from locating in the county. Employment currently is centered at St. Marys. The opening of Cumberland Island National Seashore has helped to develop tourism and its related establishments along the access road and spinoff areas in Woodbine. The developing Kings Bay Fleet Ballistic Missile Submarine Refit Site is another high employment area. A rapidly increasing population and expansion of services will make many demands upon the resources of the county. Manufacturing has dominated the economy of Camden since the early fifties with the Gilman Paper and Kraft Bag companies. Currently, the two plants account for over 70% of the employees listed in the 1974 manufacturing directory. Although some diversification will take place as access to the county improves, the paper industry will remain the prime employer in the county.

Table 3-13. Median and per capita income for Georgia coastal counties, 1970 (U.S. Department of Commerce, Bureau of the Census 1973a).

County	Median Family Income 1970	Per Capita Income 1970
Bryan	$ 6,690	$ 1,891
Camden	8,390	2,228
Chatham	8,245	2,671
Effingham	7,950	2,163
Glynn	7,958	2,566
Liberty	6,063	2,010
Long	5,414	1,630
McIntosh	5,630	1,729
Regional	$ 7,931	$ 2,520
Georgia	8,167	2,649
National	9,590	3,945

1. Income Distribution

The Georgia coastal area has a diverse economic structure. Two economic centers, Savannah and Brunswick, are sources of higher income. Employment is high in these areas, as are skill levels. The largest concentrations of white-collar and service workers are also here. All these characteristics have been combined and the term urbanization has been used to describe the conditions.

According to the Coastal Area Planning and Development Commission (1975), Camden, Chatham, and Glynn counties have the highest median income; however, Bryan and Effingham are beginning to close the gap (Table 3-13). Camden County has the highest median income of the eight counties, yet would not be classified as urbanized. The high income level reflects the influence of higher salaries paid by Gilman Paper Company (Coastal Area Planning and Development Commission 1975). Liberty County currently is showing signs of improving income averages because of the military buildup of Ft. Stewart and related activities. McIntosh and Long counties have the lowest median income of the area, reflecting primarily the lack of employment opportunities (Table 3-13).

Projections on future income distribution by income categories was not possible other than to indicate that a given number of families would fall above a median and a given number would be below. There is an additional factor that should be mentioned concerning the compromise median income projections; the rate of growth in median income between 1960 and 1970 was probably more realistic for projection purposes in the urbanized counties than for those in the process of changing from a rural to a suburban county.

Projections on the total income (Table 3-14) within a county are useful for a variety of estimates such as the volume of retail sales (mentioned later in this section), or the expected tax revenue. This, in turn, can be used in planning maintenance of existing public facilities as well as new construction.

Table 3-15 gives income data by category of employment for the Georgia coastal region. The Savannah SMSA encompasses Bryan, Chatham, and Effingham counties in this table. Manufacturing, which includes food products, textile products, lumber, printing, chemicals, and machinery, leads the other categories for income production for Savannah SMSA, Glynn, and Liberty counties.

2. Employment Trends

a. Employment. The coastal area had 5.8% of the establishments, 5.9% of the employees (in the week of March 12), and 5.5% of the payrolls of those industries covered by a statewide survey conducted in 1974 (Table 3-16). The average number of employees per establishment for the coastal region was comparable to the State average, but the counties of Camden, Effingham, Liberty, and McIntosh are characterized by a number of small business establishments.

b. Unemployment. According to the U.S. Bureau of Labor Statistics (Akioka 1978) the unemployment rate for Georgia was down from a high of 8.6% in 1975 and 8.1% in 1976 to 6.9% in 1977. The figures for 1973 (Table 3-17) show that the coastal counties have an unemployment rate that is slightly less than the State's rate of 3.9%. In 1974, Georgia's unemployment rate of 5.1% was less than that for the coastal counties, 5.9%. Liberty County, with an unemployment rate of 6.6% was the only coastal county with a rate exceeding that for the State as a whole.

c. Employment Projections. Employment projections for the Georgia coastal area were obtained from OBERS [the OBERS program is a joint undertaking between the Office of Business Economics (OBE) of the U.S. Department of Commerce and the Economic Research Service (ERS) of the U.S. Department of Agriculture; thus the acronym OBERS] Economic Area Projections and compiled by the Coastal Area Planning and Development Commission (1975). These projections are summarized in Table 3-18. All counties except Long are projected to increase in employment. Long County is projected to lose 103 employed persons (9.1%) by the year 2000, while the largest gain of 19,347 employees (26.9%) is expected in Chatham County. Liberty County employment projections do not include the military personnel at Ft. Stewart, which will be nearly equal to the civilian employment shown. Population within the counties is tied directly to the employment levels by utilizing a labor force/population. As employment increases, so will the population. This, in turn, has a direct impact on the required planning for such items as community facilities, housing, land use, etc.

Projections of the number of employees within occupational groups for the individual counties were not made by Coastal Area Planning and Development Commission (1975) because of the uncertainty of projections with such a small base. Within the Georgia coastal region, it is expected that farming will be decreasing while the remaining occupations shift emphasis somewhat but basically remain stable. Table 3-19 presents in very general terms a broad work base for the coastal region.

3. Major Business Activities

a. Agriculture. Agricultural interests in the Georgia coastal region are declining. The remaining farms are of a larger size and employ fewer workers

Table 3-14. Projected total income for Georgia coastal counties, 1975 - 2000 (in thousands of 1967 dollars) (Coastal Area Planning and Development Commission 1975).

County	1975	1980	1985	1990	1995	2000
Bryan	$18,257	22,272	28,670	34,954	42,936	52,448
Camden	37,849	49,994	64,224	79,090	104,997	131,595
Chatham	620,331	773,234	936,915	1,097,850	1,331,563	1,571,860
Effingham	41,783	56,427	74,429	95,065	125,054	159,191
Glynn	185,419	230,643	275,807	335,176	416,055	507,635
Liberty	63,526	116,630	142,643	174,556	221,589	268,186
Long	7,822	9,057	10,804	12,231	14,839	17,018
McIntosh	18,847	24,787	31,537	39,133	49,756	62,352
TOTAL	$993,834	$1,283,142	$1,566,171	$1,868,055	$2,306,789	$2,770,285

Table 3-15. Labor and proprietor's income (in thousands of dollars) by category for coastal counties of Georgia, 1972 (U.S. Department of Commerce, Bureau of Economic Analysis 1975b).

	Savannah SMSA[a]		Camden		Glynn		Liberty		McIntosh		State	
Category	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
Agriculture	3,914	0.7	586	4.8	1,268	0.8	333	0.7	137	3.1	551,135	4.3
Manufacturing	128,461	24.3	---	---	42,517	27.2	5,444	11.7	---	---	3,184,894	25.1
Construction	42,230	8.0	2,439	19.8	17,717	11.3	807	1.7	193	4.3	825,854	6.5
Trade	92,761	17.6	1,698	13.8	19,752	12.6	2,348	5.1	1,014	22.8	2,359,630	18.6
Finance, Insurance, and Real Estate	25,358	4.8	339	2.8	6,006	3.8	525	1.1	85	1.9	708,076	5.6
Transportation and Public Utilities	59,909	11.3	931	7.6	4,771	3.0	1,499	3.2	304	6.8	1,035,860	8.2
Services and Miscellaneous	80,507	15.2	1,197	9.7	21,547	13.8	1,667	3.6	813	18.3	1,597,628	12.6
Government	95,086	18.0	2,566	20.8	42,996	27.5	33,199	71.6	1,819	40.9	2,438,041	19.2
Federal Civilian	24,513	4.6	363	2.9	5,262	3.4	10,712	23.1	222	5.0	721,134	5.7
State and Local	53,119	10.1	2,008	16.3	11,634	7.4	1,912	4.1	1,454	32.7	1,213,403	9.6
Federal Military	17,456	3.3	196	1.6	26,100	16.7	20,575	44.4	144	3.2	503,504	4.0
Total	528,226		12,322		156,574		46,347		4,450		12,701,118	
Federal %		7.9		4.5		20.1		67.5		8.2		9.7

a. Savannah SMSA includes Savannah, Effingham, and Bryan counties.

Table 3-16. Number of establishments, number of employees, and amount for payroll for Georgia coastal counties, 1974 (U.S. Department of Commerce, Bureau of the Census 1976b).

Area	Number of Establishments	Employees		Annual Payroll	
		Number	Per Establishment	Total ($1,000)	Per Worker (Dollars)
Bryan	111	2,184	19.7	12,741	5,834
Camden	199	2,500+	12.6	a	a
Chatham	4,004	62,693	15.7	472,371	7,502
Effingham	160	1,009	6.3	5,431	5,383
Glynn	686	16,461	24.0	128,590	7,812
Liberty	194	1,756	9.1	11,905	6,780
McIntosh	138	826	6.0	4,284	5,186
Total	5,492	87,699	16.0	635,322	7,244
State Total	93,949	1,477,795	15.7	11,549,403	7,815

a. Figure not available.

Table 3-17. Labor force estimates, employment, and unemployment for Georgia coastal counties in 1973 and 1974 (Coastal Area Planning and Development Commission 1975).

County	Civilian Labor Force		Employed		Unemployed		Unemployed Ratio %	
	1973	1974	1973	1974	1973	1974	1973	1974
Bryan	2,327	2,323	2,230	2,196	95	127	4.2	5.5
Camden	4,670	4,882	4,530	4,305	140	577	3.0	11.8
Chatham	72,921	72,747	70,268	69,852	2,653	2,895	3.6	4.0
Effingham	4,911	4,906	4,661	4,633	250	273	5.1	5.6
Glynn	21,430	19,968	20,900	19,153	530	815	2.5	4.1
Liberty	3,930	3,889	3,760	3,634	170	255	4.3	6.6
McIntosh	2,630	2,067	2,540	1,986	90	81	3.4	3.9

Table 3-18. Employment projections in Georgia's coastal region, 1975 - 2000 (Coastal Area Planning and Development Commission 1975).

County	1975	1980	1985	1990	1995	2000
Bryan	2,550	2,707	2,842	2,963	3,097	3,215
Camden	4,834	5,461	5,950	6,349	6,946	7,453
Chatham	71,951	78,051	81,413	84,775	88,037	91,298
Effingham	5,124	5,879	6,616	7,353	8,133	8,913
Glynn	19,817	21,792	22,940	24,132	25,161	26,190
Liberty	4,427	5,003	5,373	5,759	6,150	6,541
Long	1,127	1,127	1,116	1,105	1,095	1,024
McIntosh	2,638	2,913	3,133	3,310	3,501	3,693
Total	112,468	122,933	129,383	135,746	142,120	148,327

Table 3-19. Employment projections, by occupation, for the Georgia coastal region, 1975 - 2000 (Coastal Area Planning and Development Commission 1975).

Occupation	1975	1980	1985	1990	1995	2000
Professional	14,000	14,700	15,500	16,200	17,000	17,800
Managerial	10,100	11,000	11,600	12,200	12,800	13,300
Sales	25,900	28,200	29,700	31,100	32,600	34,000
Craftsmen	16,900	18,400	19,400	20,300	21,300	22,200
Operatives	19,100	20,900	21,900	23,000	24,100	25,200
Laborers	7,900	8,600	9,000	9,500	9,900	10,400
Farmers	1,100	1,200	1,200	1,200	1,200	1,300
Services	18,000	19,600	20,700	21,700	22,700	23,700
TOTAL	113,000	122,600	129,000	135,200	141,600	147,900

than in the past, because of mechanization of agricultural activities. Although there will still be farming carried on within the region, it is expected to continue its downward trend until the farmer can make more profit by farming than by selling his land for development.

b. Coastal Fisheries. Commercial and recreational fishing play an important part of the economy of coastal Georgia. The fishing industry includes fishermen, wholesalers, processors, distributors, and many others. The number of commercial fishermen who fish as their major source of income is difficult to estimate. Seafood processing and wholesaling are major employment areas of the commercial fishing industry. In 1973, there were approximately 54 processing and wholesaling establishments in coastal Georgia, employing an average of 1,757 persons (U.S. Department of Commerce, Bureau of the Census 1976b). Processors may also have a wholesaling function; subsequently, plants that perform both functions were counted under processors.

The total dockside value of fish and shellfish landed in Georgia in 1977 totaled $9.1 million. Table 3-20 indicates by district the weight and value of shrimp, crab, and other seafood for 1977. (For a detailed discussion of the seafood industry, see Chapter Seven.)

c. Forestry. Forest products are the region's largest resource presently available. More than $13 million worth of pulpwood was harvested in 1973 to run the paper mills in the area. Forest lands with commercial value make up an estimated 73% of the region (Table 3-21). Forest management practices have insured that the pulpwood industry will not run out of raw materials. (See Chapter Six for detailed discussion on forest land.)

d. Industry and Government. Manufacturing in the Georgia coastal area accounted for 23.1% of the area's employment in 1970 (Coastal Area Planning and Development Commission 1975). The major activities were in paper and wood products, food products, textiles, and chemicals. Although projections were not made by the Coastal Area Planning and Development Commission for some of the smaller counties, it is possible to make general projections for the entire region to serve as an indicator of future growth in the region. Projections of employment in manufacturing are made in general terms in Table 3-22.

Retail and wholesale trade and services are most important in Savannah and Brunswick. In 1972, nearly 20,000 were employed in trade of some kind, amounting to nearly 20% of the work force. This rate is expected to be maintained in the future (Table 3-23).

The volume of sales within the eight coastal counties is increasing naturally as a function of increased population. In all but Long County, the indicators of sales tax receipts, sales management data, and the U.S. Census of Retail Trade are positive. The projected growth, by occupation, of the business community within the Georgia coastal area is presented in Table 3-19.

The textile industry is economically important in half of the counties within the region. It is a major Georgia industry, but has not made significant inroads on the coast. Because the firms are individually operated, it is difficult to predict their future actions and employment possibilities.

Food processing is a major activity in those counties where access to the fishing and shrimping grounds is best. The industry is having to compete with other similar activities along the east coast, but shows no signs of weakening.

Shipping is a major activity in the cities of Brunswick and Savannah. By the year 1990, world trade has been predicted to increase dramatically, and the civic and economic leaders of these cities intend to be prepared to handle the cargo. The current construction in Chatham County and proposed Colonels Island projects in Glynn County indicate their determination.

Chemical production is also a major activity in the region, serving not only the needs of the regional industries, but national demands as well.

Table 3-20. Commercial fisheries landings in Georgia coastal waters, 1977 (U.S. Department of Commerce, NOAA 1978).

District[a]	Shrimp (heads on) pounds	Shrimp (heads on) $	Blue Crabs pounds	Blue Crabs $	Finfish pounds	Finfish $
Northern	1,380,667	1,978,684	1,802,058	410,167	405,487	310,424
Central	2,144,528	3,237,968	3,935,658	805,423	344,089	195,637
Southern	1,069,380	1,625,350	1,983,952	416,502	118,837	43,471
TOTAL	4,594,575	6,842,002	7,721,668	1,632,092	868,413	549,532

a. Northern District includes Chatham and Bryan counties.

Central District includes Liberty and McIntosh counties.

Southern District includes Glynn and Camden counties.

Table 3-21. Commercial forest acreage compared with total land acreage in Georgia coastal counties, 1972 (Georgia Forestry Commission 1976).

County	Total Land (acres)	Commercial Forest (acres)	%	Change in Commercial Forest Area 1962 - 1972 Acres	%
Bryan	282,800	227,700	80.5	4,200-	1.8-
Camden	420,200	320,600	76.3	3,100	1.0
Chatham	289,400	123,300	42.6	3,100	2.6
Effingham	307,200	247,800	80.7	12,800-	4.9-
Glynn	282,600	175,500	62.1	5,200	3.1
Liberty	327,400	252,600	77.2	2,400	1.0
Long	257,900	243,000	94.2	12,000	5.2
McIntosh	287,800	200,900	69.8	25,400	14.5
Total	2,455,300	1,791,400	73.0	34,200	1.9

Table 3-22. Projected employment in manufacturing for the Georgia coastal region, 1975 - 2000 (Coastal Area Planning and Development Commission 1975).

County	1975	1980	1985	1990	1995	2000
Bryan	*	*	*	*	*	*
Camden	2,220	2,350	2,380	2,400	2,500	2,600
Chatham	14,390	15,610	16,280	16,960	17,610	18,260
Effingham	2,000	2,230	2,320	2,430	2,520	2,580
Glynn	5,150	5,670	5,740	6,030	6,040	6,290
Liberty	*	*	*	*	*	*
Long	*	*	*	*	*	*
McIntosh	*	*	*	*	*	*

*Indicates base too small to be projected.

Table 3-23. Projected retail sales in Georgia's coastal region, 1975 - 2000 (in thousands of 1967 dollars) (Coastal Area Planning and Development Commission 1975).

County	1975	1980	1985	1990	1995	2000
Bryan	$ 10,644	$ 12,985	$ 16,715	$ 20,378	$ 20,092	$ 30,577
Camden	15,556	20,548	26,396	32,506	43,154	54,086
Chatham	394,531	491,777	595,878	698,233	846,874	999,703
Effingham	13,329	18,000	23,743	30,326	39,892	50,782
Glynn	135,356	168,369	201,339	244,678	303,720	370,574
Liberty	31,445	57,731	70,608	86,405	109,687	132,752
Long	2,096	2,427	2,895	3,278	3,976	4,561
McIntosh	10,743	14,124	17,976	22,306	28,306	35,541
Total	$613,700	$785,961	$955,550	$1,138,110	$1,400,756	$1,678,576

CHAPTER FOUR

ENERGY RESOURCES

I. CONVENTIONAL ENERGY RESOURCES

Coastal areas of South Carolina and Georgia have experienced rapid growth in the past 20 years and electrical energy requirements have increased correspondingly. From 1955 to 1975, residential, commercial, and industrial needs have increased by 454.1%, 585.6%, and 380.6%, respectively (Federal Energy Administration 1976). Although these increases are large, the coastal area does not require large amounts of electricity in comparison to inland areas. In South Carolina, the power drain is located in the upstate industrial belt and in Georgia it is concentrated near metropolitan Atlanta.

While current electrical development is not concentrated in the coastal counties, existing companies provide adequate service over wide areas and maintain highly reliable capabilities. In South Carolina, several power companies established the CARVA pool in 1967 to provide for joint planning, operation of generation and transmission facilities, and the exchange of power when needed. Utilities participating in CARVA include Carolina Power and Light Company, Duke Power Company, Virginia Electric and Power Company, and South Carolina Electric and Gas. Although both South Carolina Electric and Gas (SCE&G) and the South Carolina Public Service Authority (SCPSA) serve the coastal area, SCPSA is not a member of the CARVA pool (Federal Power Commission 1970a). South Carolina Public Service Authority does, however, have an agreement with member firm SCE&G for exchange during times of crisis.

In Georgia, exchange of power is handled by the Southern Company System, which services 315,890 km^2 (122,000 mi^2) in Alabama, Georgia, northwest Florida, and southeastern Mississippi. This pool began in 1925 and now has six affiliates, Alabama Power Company, Georgia Power Company, Gulf Power Company, Mississippi Power Company, Southern Electric Generating Company, and Southern Services, Inc. (engineering satellite) (Federal Power Commission 1970a).

Although major exchange pools such as CARVA and the Southern Company System do not regularly exchange outside their areas, South Carolina Electric and Gas and Georgia Power Company trade on a limited daily basis according to the local need (T. E. Holland, 1978, Georgia Public Service Commission, Atlanta, pers. comm.).

A. SOUTH CAROLINA PRODUCTION AND PROJECTED DEVELOPMENT

In coastal South Carolina, electric power is produced by South Carolina Electric and Gas (SCE&G) and the South Carolina Public Service Authority (SCPSA). Their total generating capacity in 1977 was 2,844 MW (Table 4-1). Electric generating plant locations and major transmission lines are shown on Atlas plate 30.

Table 4-2 indicates present generating capacity by type and projected development as envisioned by the Federal Energy Administration in 1976. Nuclear generation showed the greatest increase with coal-fueled plants a distant second. Recent energy crises support such a trend, although numerous environmental and social difficulties must be overcome. At present, no nuclear generating facilities exist in coastal South Carolina and none are planned through the 1990's (Sharp 1978). Primary reasons for not locating nuclear facilities on the coast include lack of available fresh water and existing seismic conditions (see Volume I).

Proposed expansion of South Carolina Electric and Gas Company power plant facilities is limited. Over the next decade, only the Williams and Hagood plants, located in Berkeley and Charleston counties, will be expanded. No other sites for power plants in coastal South Carolina have been established due to the delicacy of the coastal environment. Although initial plans had been made for fossil fuel and nuclear generating expansion for coastal South Carolina, these plans have been abandoned because of Federal and State environmental restraints.

Planned expansion of South Carolina Public Service Authority power plant facilities is presently coincidental with industrial development of the coastal zone. Alumax, Inc., a large primary aluminum reduction plant to be constructed in Berkeley County, will need an enormous amount of electrical energy. The SCPSA plans to expand the Winyah generating facility by one-third to accommodate this industry. Additional proposed sites and expansions are planned as a result of rediverting the Santee River. These sites are discussed in Volume I, Chapter Six in conjunction with impacts of rediversion. Like SCE&G, other plans for the Public Service Authority's future power plant sitings in coastal South Carolina have been altered due to ecological and legal restraints within the coastal area.

Hydroelectric facilities serving coastal South Carolina are limited. Two major water reservoirs are the sources

Table 4-1. Generation facility, fuel type, and generating capacity of SCPSA and SCE&G power plants in coastal South Carolina (South Carolina Electric and Gas Company 1977, South Carolina Public Service Authority 1977).

South Carolina Public Service Authority

Type Plant/Name	Energy Source	Generating Capacity (MW)[a]
Fossil Fuel		
Winyah Steam	Coal	630
Jeffries Steam	Coal	446
Grainger Turbine	Coal	170
Myrtle Beach Turbine	#6 Fuel Oil	88
Hilton Head Turbine	#6 Fuel Oil	39
Hydroelectric		
Wilson Hydro	Water Pressure	2
Jeffries Hydro	Water Pressure	133

South Carolina Electric & Gas Company

Type Plant/Name	Energy Source	Generating Capacity (MW)[a]
Fossil Fuel		
Williams Steam	#6 Fuel Oil	633
Williams Turbine	Natural Gas	54
Hagood Steam	#6 Fuel Oil	98
Faber Place Turbine	Natural Gas	11
Canadys Steam	Coal	473
Canadys Turbine	Natural Gas	16
Burton Turbine	Natural Gas	35
Hardeeville Turbine	Natural Gas	16

a. Manufacturer's maximum nameplate rating in megawatts (MW) of the generators.

Table 4-2. Existing and projected generating capacities, in megawatts (MW), for South Carolina as of 1976 (Federal Energy Administration 1976).

	Existing		Projected		Total	
	MW	%	MW	%	MW	%
Nuclear	3,403	30	7,204	80	10,607	52
Hydro	1,770	16	480	05	2,250	11
Oil	2,415	22	0	0	2,415	12
Coal	3,351	30	815	09	4,166	21
Gas	56	0	0	0	56	0
Unknown	176	02	560	06	736	04
Other	0	0	0	0	0	0
Total	11,171	100	9,059	100	20,230	100

for the SCPSA's hydroelectric and steam generating plants located at Wilson and Jeffries. These two reservoirs are Lake Marion and Lake Moultrie. These lakes were created as part of the Santee-Cooper project which was completed in 1942 by the South Carolina Public Service Authority. Connected by a diversion canal, both lakes have hydroelectric plants. The upper lake, Lake Marion, was formed by impounding the Santee River with dikes and Wilson Dam. This dam has a small hydroelectric plant, which discharges into the Santee River. The lower lake, Lake Moultrie, was formed by dikes and a dam on the Cooper River and is largely supplied by the diversion canal from Lake Marion. Total acreage for Lake Marion and Lake Moultrie is 44,760 ha (110,600 acres) and 24,444 ha (60,400 acres), respectively. Storage capacity for the two lakes is 1,110,000 acre-feet for Lake Marion and 760,000 acre-feet for Lake Moultrie (U.S. Army Corps of Engineers 1975a).

Hydroelectric potential for South Carolina was estimated to be 50% higher than the 1970 level of development, and the projected annual increase was only 5% (Federal Power Commission 1970b). Additional development is most likely in the Santee Basin at St. Stephen and at Lake Hartwell on the Savannah River (Federal Power Commission 1970a).

B. GEORGIA PRODUCTION AND PROJECTED DEVELOPMENT

Power in coastal Georgia is generated primarily by Savannah Electric and Power Company and the Georgia Power Company. Current generating capacity (1,907 MW) is concentrated in Savannah and Brunswick (Table 4-3). Generating facilities and transmission lines are shown on Atlas plate 28.

Savannah Electric and Power Company (SEPC) produces electric power only for metropolitan Savannah. SEPC maintains an interchange with Georgia Power to aid during times of shortage, but Georgia Power, through its rural electric cooperatives, services the remainder of coastal Georgia. In extreme southern Georgia there is an intertie with Florida Power Corporation at Jasper, Florida. This power exchange is part of the Southern Company's agreement with Georgia Power.

Although most of coastal Georgia's power is produced by conventional turbine methods, Georgia Power Company's Hatch Nuclear Plant at Baxley, Georgia, also contributes to the coastal counties. The Hatch Plant is located approximately 97 km (60 mi) inland in Appling County.

Nationwide, projected electric development is expected to rely heavily on

Table 4-3. Location, type of fuel, and generating capacities (MW) of existing generating plants in coastal Georgia (W. B. Evans, 1978, Georgia Public Service Commission, Atlanta, pers. comm.).

Savannah Electric and Power Company			
Plant	Location	Generating Capacity (MW)	Fuel Type
Port Wentworth	Savannah	323.0	oil-gas-coal
Port Wentworth	Savannah	16.5	oil
Boulevard	Savannah	46.8	oil
Riverside	Savannah	82.0	oil-gas
Effingham (under development)	Rincon	175.0	oil-gas

Georgia Power Company			
Plant	Location	Generating Capacity (MW)	Fuel Type
McManus	Brunswick	629.0	steam-gas
Hatch	Baxley	810.0	nuclear

increased nuclear facilities with a gradual decrease in hydroelectric power and a dramatic increase in dependence on fossil fuel plants (Federal Power Commission 1970a). Projected electric generation trends for the Sea Island Coastal Region differ somewhat from national projections, as evidenced by the Georgia projections found in Table 4-4.

Short-term projected development includes the Effingham plant at Rincon, Georgia, owned by Savannah Electric and Power Company. This oil and gas turbine plant in southeastern Effingham County, has an output of 175 MW (W. B. Evans, 1978, Savannah Electric and Power Company, Savannah, pers. comm.). Georgia Power has also increased output of the Hatch nuclear facility by 820 MW (T. E. Holland, 1978, Georgia Public Service Commission, Atlanta, pers. comm.). This has more than doubled the Hatch output and contributed significantly to power needs of coastal counties. Additionally, development of Georgia Power's Vogtle nuclear plant in Waynesboro will add 1,160 MW in 1983. This will be supplemented by an increase of 1,160 MW in 1984, but the amount of electricity from the Vogtle plant that will supply the coast is unknown (T. E. Holland, 1978, Georgia Public Service Commission, Atlanta, pers. comm.; W. B. Evans, 1978, Savannah Electric Power Company, Savannah, pers. comm.).

C. REGIONAL DEVELOPMENT

In the Sea Island Coastal Region, principal demand for increased electric power will remain centralized in the metropolitan areas of Charleston, South Carolina; Savannah, Georgia; and Brunswick, Georgia (Table 4-5). Electric power production is expected to remain concentrated in the Piedmont industrial areas of South Carolina and Georgia.

Projected Southeastern electrical generation through 1990 shows a general increase in nuclear development with gradual reduction in conventional methods of generation (Table 4-6).

II. NUCLEAR ENERGY RESOURCES

As the need for additional sources of electric power became evident in 1974, nuclear generation plants received increased attention. Floating offshore nuclear generating facilties were suggested as an alternative to siting problems that included increased distances from metropolitan areas, zoning regulations, and rising land prices. However, more recent indications are that this concept has been abandoned indefinitely for the East and Gulf coasts (K. Nemeth, 1978, Southern Interstate Nuclear Regulatory Board, Atlanta, pers. comm.). At present,

Table 4-4. Existing and projected electric power generation, by fuel type. for Georgia (Federal Energy Administration 1976).

	Existing		Projected		Total	
Fuel Type	MW	%	MW	%	MW	%
Nuclear	1,636	11	3,280	27	4,916	18
Hydro	1,613	11	1,381	12	2,994	11
Oil	356	03	413	03	769	03
Coal	9,537	64	4,760	40	14,297	54
Gas	353	02	0	0	353	01
Unknown	1,307	09	2,168	18	3,475	13
Other	0	0	0	0	0	0
Total	14,802	100	12,002	100	26,804	100

Table 4-5. Estimated summer peak demands (MW) in the principal electricity load centers of coastal South Carolina and Georgia (Federal Power Commission 1970a).

	1970	1980	1990
Brunswick-Waycross	200	386	800
Savannah	289	557	1,154
Charleston	453	971	2,107

Table 4-6. Trends in electric generation, by type of fuel and hydro power, for the Southeast Region from 1966 to 1990 (Federal Power Commission 1970a).

	1966		1970		1975		1980		1985		1990	
	Billion kWh	Percent	Billion kWh	Percent	Billion kWh	Percent	Billion kWh	Percent	Billion kWh	Percent	Billion kWh	Percent
Thermal generation:												
Coal	161.1	73.6	218.1	74.7	245.8	57.0	259.4	41.8	282.3	32.9	316.4	26.9
Oil	18.0	8.2	14.7	5.0	12.4	2.9	12.4	2.0	13.0	1.5	12.3	1.0
Gas	14.8	6.8	23.2	7.9	22.8	5.3	24.6	4.0	36.5	4.3	45.3	3.9
Nuclear			7.2	2.5	114.5	26.6	286.7	46.3	487.2	56.8	761.3	64.7
Internal Combustion			0.3	0.1	0.1		0.1		0.3		0.3	
TOTAL	193.9	88.6	263.5	90.2	395.6	91.8	583.2	94.1	819.3	95.5	1,135.6	96.5
Hydro generation:												
Conventional	25.0	11.4	28.7	9.8	31.8	7.4	31.8	5.1	29.7	3.5	27.5	2.3
Pumped Storage					3.6	0.8	4.8	0.8	8.8	1.0	13.8	1.2
TOTAL	25.0	11.4	28.7	9.8	35.4	8.2	36.6	5.9	38.5	4.5	41.3	3.5
TOTAL GENERATION	218.9	100.0	292.2	100.0	431.0	100.0	619.8	100.0	857.8	100.0	1,176.9	100.0

there are no land-based nuclear plants in the Sea Island Coastal Region.

III. SOLAR ENERGY RESOURCES

The amount of solar energy reaching the earth's surface is so great that it is almost incomprehensible. In the United States, the solar energy that reaches 1/500th of the country, an area smaller than that of Massachusetts, if converted at 20% efficiency, could satisfy all of the Nation's present needs for electric power (Eaton 1976). Each day the continental United States receives approximately 1,400 BTU's (British Thermal Units) of energy from the sun.

Two disadvantages of solar energy pose challenges to development of economical solar energy systems. The sunlight reaching the earth is diffuse and intermittent. Since only a small amount of light arrives at one location, solar energy must be collected and stored until needed.

The transformation of solar energy into electricity can be accomplished by a number of conversion methods. The four major methods are wind power, solar thermal energy, photovoltaic energy, and ocean thermal energy. Descriptions of these four conversion methods can be found in reports by Eaton (1976) and the U.S. Energy Research and Development Administration (1975). A series of four papers discussing solar energy production utilizing these methods has also been reported by Hammond (1977), Hammond and Metz (1977), and Metz (1977a, b).

IV. OIL AND GAS RESOURCES

Since the energy crisis of the early 1970's, increased attention has been given to oil exploration in the United States. Offshore areas have been found to be particularly productive; 19.5% of the Nation's oil production and 16% of our natural gas production in 1974 came from offshore wells (U.S. Congress 1974). With the inclusion of the estimated potential provided by outer continental shelf areas within the 322 km (200 mi) limit, America's production could be doubled (U.S. Congress 1974).

Oil, or crude petroleum, and gas are found beneath the surface of the earth both onshore and on the continental shelf. The key geologic requisites are marine sediment as a source of hydrocarbons, porous rocks to accumulate the hydrocarbons, and impervious capping rocks to prevent these hydrocarbons from escaping (U.S. Department of Interior 1974). More complete geology and stratigraphy of South Carolina and Georgia can be found in Volume I, Chapter Two.

Results of onshore exploration in the Atlantic Coastal Plain of South Carolina and Georgia have historically been discouraging. Stratigraphic thickness of less than 1,219 m (4,000 ft) in this area precludes the probability of oil or gas deposits of commercial value (Olson 1973). Since the geology of the lower coastal plain of South Carolina and Georgia does not differ significantly, future hope for petroleum development lies primarily offshore (Pickering 1974).

On the Atlantic coast, major interest in offshore exploration centers on four areas: Georges Bank in the North Atlantic, Baltimore Canyon in the Middle Atlantic, Southeast Georgia Embayment, and Blake Plateau in the South Atlantic (Fig. 4-1). Areas of particular interest to South Carolina and Georgia are the Southeast Georgia Embayment and the Blake Plateau. Although preliminary structural and stratigraphic investigations have been conducted, no marketable quantities of oil or gas have yet been discovered in the South Atlantic outer continental shelf (OCS).

The offshore potential for South Carolina and Georgia is very similar. Initial exploration is underway in the Southeast Georgia Embayment, an area of approximately 8.4 million ha (20.7 million acres) (U.S. Department of Interior, Bureau of Land Management 1977b). Leasing of favored areas began in 1978, with production estimated to start in 1982. Specific locations of leased tracts are shown in Figure 4-2. Although 144 tracts, covering 331,776 ha (819,836 acres), were offered for lease in the South Atlantic region, a total of only 43 tracts were actually leased. The total area leased was 99,072 ha (244,812 acres) (D. Donate, 1978, U.S. Department of Interior, Bureau of Land Management, New Orleans, pers. comm.). On this property 95 to 220 exploratory wells are anticipated if initial exploration is favorable. Peak production should include 160 to 500 wells, but these will be situated on only 10 to 25 platforms (U.S. Department of Interior, Bureau of Land Management 1977b).

More importance has been placed on the potential of the Blake Plateau, an area approximately 242 km (approximately 150 mi) offshore from South Carolina and Georgia (U.S. Department of Interior, Bureau of Land Management 1977b). The Blake Plateau region is of major interest because it is geologically similar to the rich oil-producing areas of the Tampico Embayment and the Saudi Arabian side of the Persian Gulf. These areas share an early history of marine deposition in a subtropical environment present some 180 to 230 million years ago (Olson 1974). Additionally, the northern edge of Blake Plateau is known to have sedimentary

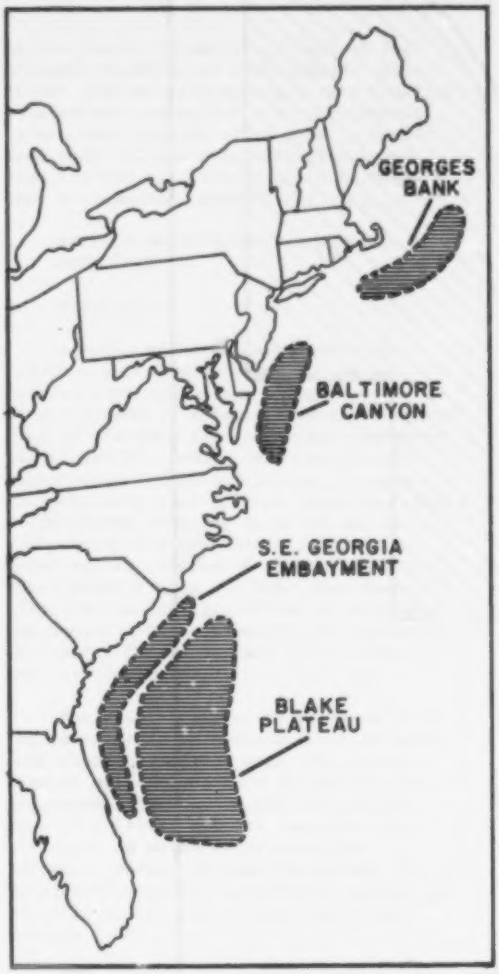

Figure 4-1. The four most promising areas for production of natural gas and oil on the Atlantic outer continental shelf. (U.S. Department of Interior, Bureau of Land Management 1977b).

structures with thicknesses in excess of 3,048 m (10,000 ft) (Maher and Applin 1971). Hope for successful development of the Southeast Georgia Embayment, including the Blake Plateau, is high. This area is several times larger than the geologically similar petroleum producing areas of the Persian Gulf.

At present no sure way exists to determine the availability of gas and oil reserves off the South Carolina-Georgia coast short of exploratory drilling. Plate's (1976) report for the Charleston Trident Chamber of Commerce indicates that extensive geological surveys and seismographic operations have been conducted in the entire Atlantic OCS since the late 1930's. These surveys have yielded sufficient scientific data to indicate potential oil resources of between 2 billion to 4 billion barrels and 142 billion to 425 billion m^3 (5 trillion to 15 trillion ft^3) of gas. The U.S. Department of Interior, Bureau of Land Management (1977b) reported that the 225 tracts proposed for leasing off the South Atlantic could contain undiscovered recoverable resources ranging from 0.28 billion to 1.0 billion barrels of oil and 54 billion to 192 billion m^3 (1.9 trillion to 6.8 trillion ft^3) of gas. Based on these estimates, proposed offshore development may result in peak daily production of between 56 thousand to 170 thousand barrels of oil and 13 million to 40 million m^3 (0.47 billion to 1.4 billion ft^3) of gas, peaking approximately 14 years after production has begun. Estimated production life is 25 years. Another estimate of oil and gas resources in the Atlantic OCS is reported by the Council on Environmental Quality (1974). This report does not distinguish among Georges Bank Trough, Baltimore Canyon Trough, and Southeast Georgia Embayment. Rather, the Atlantic OCS is treated as one province stretching from the Canadian border to Florida. Estimates of undiscovered economically recoverable crude oil and natural gas range from 5 billion to 20 billion barrels and from 991 billion to 3.1 trillion m^3 (35 trillion to 110 trillion ft^3), respectively.

An analysis of the total Atlantic estimated recoverable oil resources is presented in U.S. Geological Survey Open File Report No. 75-411 (U.S. Department of Interior, Geological Survey 1975). A conservative interpretation of these figures shows estimated reserves in the South Atlantic (Southeast Georgia Embayment and Blake Plateau) to be less than half a billion barrels of oil and about 19.8 billions m^3 (700 billion ft^3) of gas. Some industry representatives consider even these figures to be optimistic; however, they emphasize that reserves cannot be determined with any great degree of certainty until exploratory drilling has taken place.

While neither South Carolina nor Georgia has had past experience with petroleum development, both States have formal policies for future development. These policies express support of offshore oil and gas development provided that adequate protection is granted environmental, social, and economic resources.

South Carolina's policy is based on legislative resolution while Georgia's policy is administrative in origin. Both States share concern over the protection of fragile coastal ecosystems and the industries they support. Additional concern has been voiced for social needs

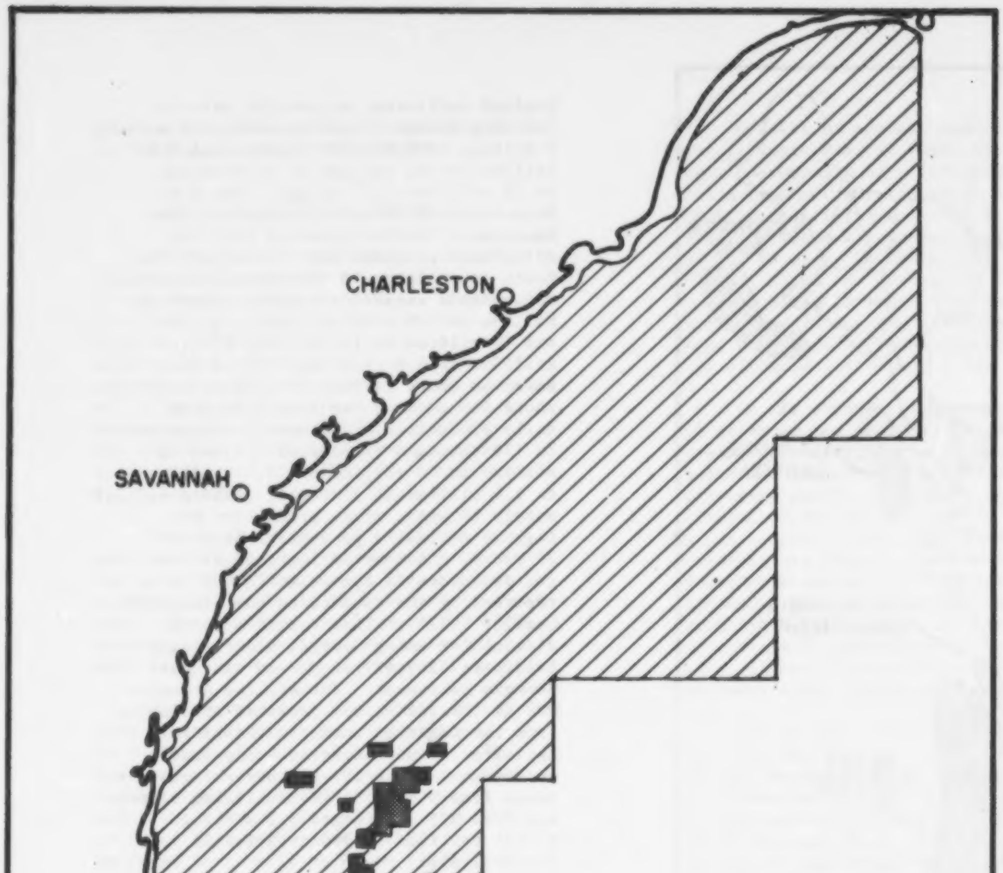
CHARLESTON
SAVANNAH
JACKSONVILLE
CAPE CANAVERAL
OFFERED FOR LEASE OCS SALE 43
LEASED TRACTS
0 40 80 120 MILES
0 40 80 120 160 KILOMETERS

Figure 4-2. Location of OCS leased tracts from South Atlantic sale no. 43 (U.S. Department of Interior, Geological Survey 1978).

of the coastal areas as related to the economic benefits of development. Both States also believe strongly that baseline studies are prerequisite to development, as are the creation of an orderly development plan and guarantees of fiscal aid from the Federal Government (U.S. Department of Commerce, NOAA 1977a).

A. EFFECTS OF OFFSHORE OIL AND GAS DEVELOPMENT

1. Offshore

Adverse effects associated with offshore petroleum production can be divided into four major categories: 1) developmental effects from the construction of platform facilities and transport pipelines; 2) chronic small spills; 3) catastrophic crude spills; and 4) catastrophic spills of refined products. Since no develoment has yet occurred nor have the coasts of either State suffered a major spill, studies of oil spills and their effects have not been done for either State (Georgia Office of Planning and Budget 1974). However, the potential is rapidly increasing and this problem must be considered.

The initial impact of offshore drilling is expected to produce minor adverse conditions associated with the introduction of drilling muds to the marine environment. Between 58,650 and 720,000 tons of drilling mud are expected from all types of wells (U.S. Department of Interior, Bureau of Land Management 1977b). No significant adverse effects are expected under normal operations (Clark and Terrell 1978).

Pipeline construction for transport of crude petroleum and natural gas to the mainland will also produce some adverse effects. Laying of 257 to 515 km (160 to 320 mi) of pipeline will require a projected 928,688 to 1,957,376 m^3 (1,280,000 to 2,560,000 yds^3) of dredged sediments (U.S. Department of Interior, Bureau of Land Management 1977b).

Little information exists on chronic pollution by oil production, but some indications suggest that it may be more damaging on a permanent basis than large catastrophic spills (Blumer et al. 1973, Gillman 1977).

Catastrophic oil spills are best known for the immediate problems they present and the attention they receive. Several factors contribute to the level of adverse biological impact created by spills as reported by the South Carolina Joint Legislative Committee to Study Oil and Gas (South Carolina General Assembly 1976):

1) Type of oil spilled--crude or refined product
2) Physiography of the area--small, confined areas concentrate the damage
3) Amount spilled
4) Weather conditions--spill is highly subject to wind dispersal
5) Biota of the area
6) Season
7) Previous exposure
8) Ambient pollution level
9) Treatment methods.

Since World War II, the coasts of South Carolina and Georgia have been spared major oil spills. During the war, large amounts of oil, both crude and refined, were washed ashore after tankers were sunk. Ocracoke Island, North Carolina, alone received an estimated 161,500 barrels of gasoline and fuel oil, but no assessment studies were conducted (Campbell et al. 1977).

Spillage of large amounts of crude oil can be extremely detrimental to sea birds, marine mammals, reptiles, marsh vegetation, fish, and benthic life forms. The Santa Barbara, California, spill was particularly lethal to diving sea birds and one species of intertidal barnacle, although recovery began within 8 weeks (Straughan 1973). Small marine life and shore vegetation also suffer both from smothering and chemical toxicity. While benthic marine life and larval fishes are often eliminated, marsh vegetation normally will resprout after the initially coated foliage is destroyed. However, such recovery is not as successful in spills of refined products or chronic contamination (Boesch et al. 1974). (See Volume III, Chapter Two for additional discussion of impacts of oil spills on marine birds.)

Refined hydrocarbon products, particularly the aromatics, are highly toxic since they are water soluble and capable of continued toxicity in dilution (Boesch et al. 1974). Concentrations as low as 0.1 ppm may be toxic to larval forms of marine life (Clark and Terrell 1978). Spills of gasoline, kerosene, naphtha, and #2 fuel oil have caused massive documented kills at all levels of the marine environment and are known to have long-term trace contamination tendencies (Boesch et al. 1974, Council on Environmental Quality 1974, Moore et al. 1974).

An analysis of past offshore oil pollution reveals that offshore drilling accounts for an extremely small percentage of pollution, while a large portion is attributed to tanker operations (Tables 4-7 and 4-8). The oil industry has drilled more than 18,000 offshore wells, but

Table 4-7. Percent incidence of man-induced oil present in the offshore marine environments, by source (American Gas Association 1973).

Oil Tankers	28%
Other Marine Vessels	19%
Automobile Crankcase Oil	30%
Industrial Waste	21%
Marine Drilling Operations	2%

Table 4-8. Oil spill frequency estimates by potential source for the South Atlantic lease area OCS Lease Sale No. 43 (U.S. Department of Interior, Bureau of Land Management 1977b).

	Expected Number	Probability of at Least One Spill
A. Spills >1,000 bbl		
Platforms	1.5	0.78
Pipelines	1.7	0.81
Tankers	2.2	0.89
Platforms and pipelines	3.2	0.96
Platforms and tankers	3.8	0.98
B. Spills 50 - 1,000 bbl		
Platforms and pipelines	32	>0.99
Tankers		>0.99
C. Spills 0 - 50 bbl (Mean size approx. = 1 bbl)		
Platforms and Pipelines	2,338	>0.99
Tankers	277	>0.99

bbl - barrels

claims to have suffered only four major oil spills (American Petroleum Institute 1975). Non-industry estimates, however, have placed a 70% probability of a spill greater than 1,000 barrels occurring (Council on Environmental Quality 1974). The petroleum industry tends to minimize the probability of a spill reaching the shore, with odds at 50,000 to 1, but local weather and seasonal factors play an important role (American Petroleum Institute 1975). The probability of a spill reaching shore from the center of the Southeast Georgia Embayment offshore oil lease area has been projected from the results of hypothetical oil spill trajectory model runs. These results show that 3% of the oil spill would reach Georgia's coast and 12% would land on South Carolina's coast, taking from 14 to 58 days to reach the shore, depending upon the season (U.S. Department of Interior, Bureau of Land Management 1977b). Spill frequency for the Southeastern region can be found in Table 4-8.

Although predictions have also been made for the effects of possible chronic spillage (Fig. 4-3), these predictions are dependent on the physical and chemical properties of the oil, motion of the water, and general climatological conditions. Current predictions of spill behavior are risky as the confidence level is extremely low (Stolzenback et al. 1977).

In addition to the individual companies involved, offshore oil production is heavily monitored and regulated by several Federal agencies. Responsible regulatory agencies include the Bureau of Land Management and the Geological Survey of the U.S. Department of Interior; the Coast Guard of the U.S. Department of Transportation; U.S. Federal Power Commission; and the U.S. Environmental Protection Agency. In the event of an oil spill, the U.S. Coast Guard has developed a contingency plan for the South Atlantic region to provide for cleanup activities, coordination with other Federal agencies, and cooperation with the States affected.

In South Carolina, the S.C. Department of Health and Environmental Control is responsible for cleanup activities. In Georgia, this task is handled by the Environmental Protection Division of the Georgia Department of Natural Resources (U.S. Coast Guard 1977).

2. Onshore

Onshore impacts associated with offshore production are expected to include construction of staging areas for various phases of the oil recovery operation. Staging areas consist of operation bases, oil terminals, gas processing plants, oil storage facilities, oil refineries, and transmission systems. Estimated land requirements for the initial phase of development in the Southeast Georgia Embayment are found in Table 4-9.

Activities that are expected to disturb the nearshore-onshore environment include dredge and fill operations associated with navigational improvements, pier installation, facilities site preparation, product transmission-line construction, construction of stormwater conveyance systems, solid and wastewater disposal, and groundwater withdrawal (Clark and Terrell 1978).

The future impact of offshore oil exploration in the coastal area was studied in Georgia in 1974 (Georgia Office of Planning and Budget 1974), and for both South Carolina and Georgia in 1975 (Robert R. Nathan Associates and Coastal Zone Resources Corporation 1975). Possible locations for facilities development were presented, including sites for offshore terminals, pipeline systems, tank

Table 4-9. Estimated range of land use requirements for directly related onshore facilities, excluding pipeline right-of-way (U.S. Department of Interior, Bureau of Land Management 1977b).

Facility	Number	Size in hectares (acres)
Onshore operation bases	1 - 3	20 - 60 (50 - 150)
Onshore oil terminals	1 - 2	16 - 32 (40 - 80)
Onshore gas processing plants	1 - 2	8 - 16 (20 - 40)
Total		44 - 108 (110 - 270)

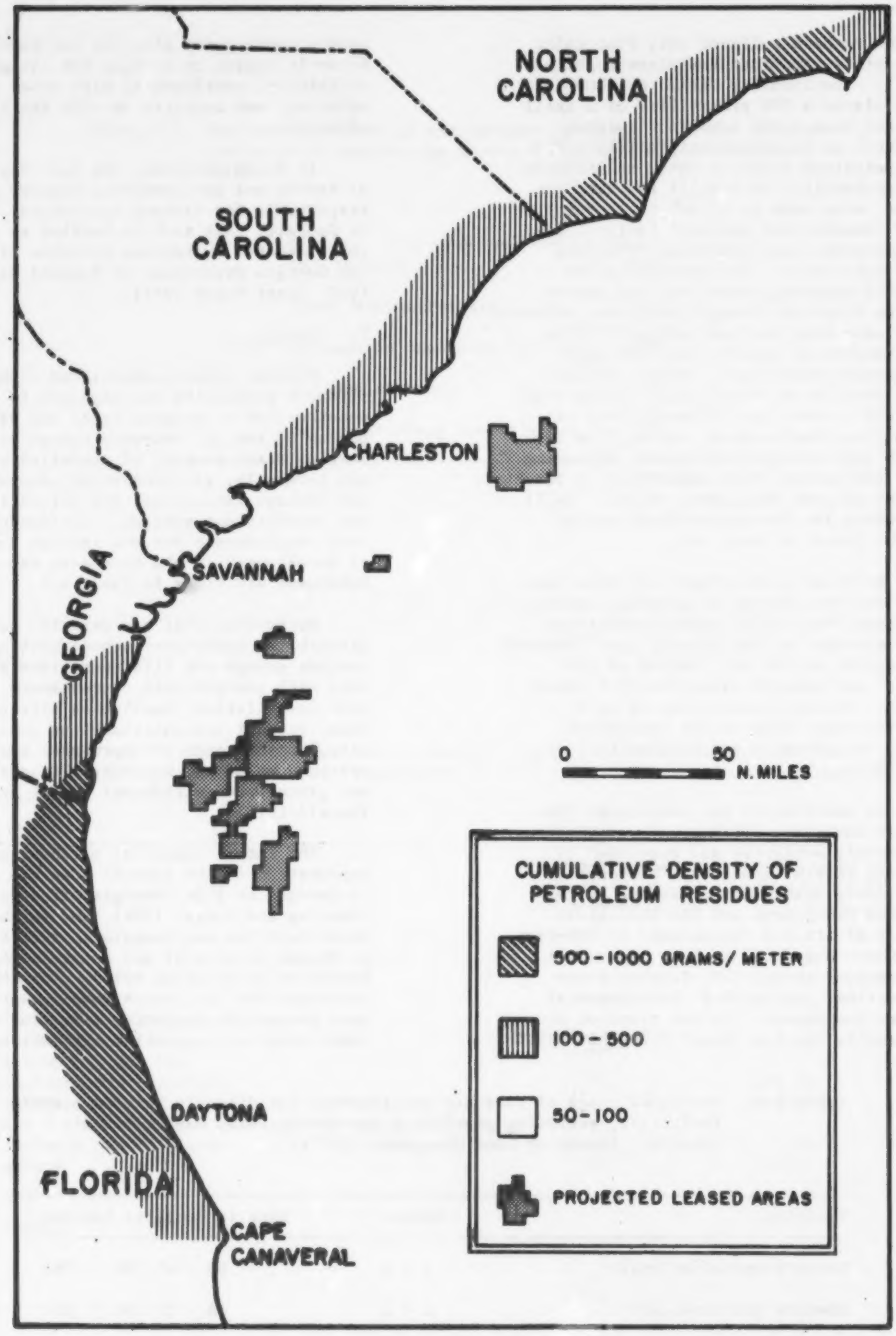
NORTH CAROLINA
SOUTH CAROLINA
CHARLESTON
SAVANNAH
GEORGIA
DAYTONA
FLORIDA
CAPE CANAVERAL
0 50 N. MILES
CUMULATIVE DENSITY OF PETROLEUM RESIDUES
500-1000 GRAMS/METER
100-500
50-100
PROJECTED LEASED AREAS

Figure 4-3. Projected cumulative distribution of petroleum residues on South Atlantic beaches resulting from small-scale, chronic spillage during the production life of the lease area. Estimated densities do not include existing background levels resulting from tanker washings and natural seeps (U.S. Department of Interior, Bureau of Land Management 1977b).

farms, and petroleum refineries. The results of these studies suggest that the two most favorable areas for the concentrated industrial development associated with offshore production are Charleston, South Carolina, and Savannah, Georgia. Selection was based primarily on adequate channel depth, suitable upland sites, and the availability of adequate existing support facilities (Georgia Office of Planning and Budget 1974, Robert R. Nathan Associates and Coastal Zone Resources Corporation 1975).

In addition to the environmental impact, there are many economic impacts that must also be considered. Increases in employment and population result in increased demands on such community facilities as housing, public utilities and services, transportation, schools, recreation, and commercial facilities. These social implications also place additional demands on natural systems such as park areas, recreational waters, and general wildlife habitat. However, the economic impacts of oil development depend on the size of the project, its level of success, and duration (Zinn 1978). Therefore, impacts resulting from a dramatic reduction in project work force after a peak period must also be considered.

Since neither South Carolina nor Georgia produces or refines petroleum products, these commodities must continually be imported. For the coastal area, most of these products arrive by ship and are stored prior to distribution via rail, barge, or truck to other locations. Storage facilities are therefore concentrated in the principal ports of Charleston, Savannah, and Brunswick. See the Atlas for locations of petroleum storage facilities.

B. NATURAL GAS

Natural gas rarely occurs in solitary commercial deposits that are commercially valuable, but is a common by-product of oil recovery. In association with oil, natural gas trapped in oil pools may be free in pockets, dissolved in oil, dissolved in water, or reduced to a liquid.

The main constituent of natural gas is methane, but there are also paraffin hydrocarbons present in varying amounts, depending on the individual deposit. Such gases as propane, butane, and ethane are most commonly present in liquid form. These, as well as other impurities such as hydrogen sulfide, nitrogen, carbon dioxide, and water, are removed as by-products during commercial production of gas.

At present, no natural gas production exists in either South Carolina or Georgia. Consumption of natural gas is low in South Carolina, with 3.7 billion m^3 (131,991 million ft^3) used in 1974. In Georgia, natural gas consumption is considerably higher, amounting to 9 billion m^3 (330,339 million ft^3) in 1974 (U.S. Department of Interior, Bureau of Mines 1975).

Estimates of natural gas potential in the Georgia Embayment - Blake Plateau Region range from 53 billion to 193 billion m^3 (1.89 trillion to 6.81 trillion ft^3) (U.S Department of Interior, Bureau of Land Management 1977b). Although both private industry and the government sector remain optimistic concerning this estimate, supplementary supplies would probably still be needed in the long run to meet the region's needs.

The impact of natural gas production does not differ markedly from oil production, as gas is a by-product. Gas lines must be laid from platforms to the shore; gas processing plants must be constructed with their attendant site disturbance and utilities demands. One of the more important necessities, however, is their dependence on groundwater. As part of their cooling process, gas plants can use up to 750,000 gallons of water per day (Clark et al. 1978). The economic impacts of natural gas production are similar to those of oil.

C. LIQUEFIED NATURAL GAS

Natural gas production in the United States peaked in 1972 at approximately 59 billion m^3 (21 trillion ft^3) (Shell Oil Company 1973). Since production is expected to decline 50% by 1990 (Shell Oil Company 1973), importation of natural gas using cryogenics began in April 1976.

Liquefied natural gas (LNG) is processed at liquefaction plants in or near oil fields. Here the production of LNG requires reduction of natural gas to -127°C (-260°F). This allows the gas to become compressed to 1/600th of its original volume. Placed under additional pressure, the liquid is pumped aboard specially designed tankers for transport.

The transfer of LNG back into commercial natural gas is accomplished at a regasification plant. The process is essentially reversed with the LNG again placed under high pressure, heated to 15.5°C (60°F), and vaporized into its normal gaseous state.

At present, two LNG terminals are located on the east coast, one at Cove Point, Maryland, and the other at Savannah, Georgia. However, due to the high cost of LNG transport and facilities development, projected use nationally of this product is only 45 billion m^3 (1.6 trillion ft^3) by 1990 (Shell Oil Company 1973). This figure represents only 8% of the total U.S. projected gas supply.

Six miles (9.7 km) east of Savannah at Elba Island (10 mi [16.1 km] from the coast), the Southern Energy Company operates the only LNG facility in the South Atlantic region. This regasification facility handles the importation of LNG via tankers with a capacity of approximately 125,000 m^3 (4.4 million ft^3). There are three double-walled storage tanks on site, each with 400,000 barrel capacity (U.S. Coast Guard 1977).

Although no LNG facilities are located in South Carolina, the General Dynamics, Inc., fuel container fabrication plant is located on the Cooper River. Located at Bushy Park, this 91 acre (36.8 ha) Charleston facility of the Quincy Ship Building Corporation produces LNG containers for installment in ships built in Massachusetts. After production, the enormous LNG containers (Fig. 4-4) are transported by barge down the Cooper River and offshore to Quincy, Massachusetts.

LNG is extremely hazardous to handle due to its flammability and explosive qualities. Although other properties are associated with this cryogenic liquid, the most important property is the potential creation of a highly flammable cloud known to be dangerous in excess of 200 mi (322 km) downwind of any spill site (U.S. Coast Guard 1977). As a precautionary measure whenever LNG tankers are within channel bounds enroute to or from Elba Island, all other ship movement is restricted from the northern end of Elba Island to Savannah lighted Buoy "T." In the event of accidents involving LNG, the Coast Guard has developed a contingency plan detailing safety procedures as well as actions to protect the environment.

In addition to the hazardous properties of liquefied natural gas, environmental impacts associated with LNG production include site preparation (often including 200 to 1,000 acres [81 to 405 ha] for safety) and the construction of marine terminals, turning basins, and adequate channels in order to service deep draft tankers. Other impacts include pipeline construction, stormwater runoff from tanks and paved areas, heavy groundwater use, and wastewater produced from heating and cooling (Clark and Terrell 1978).

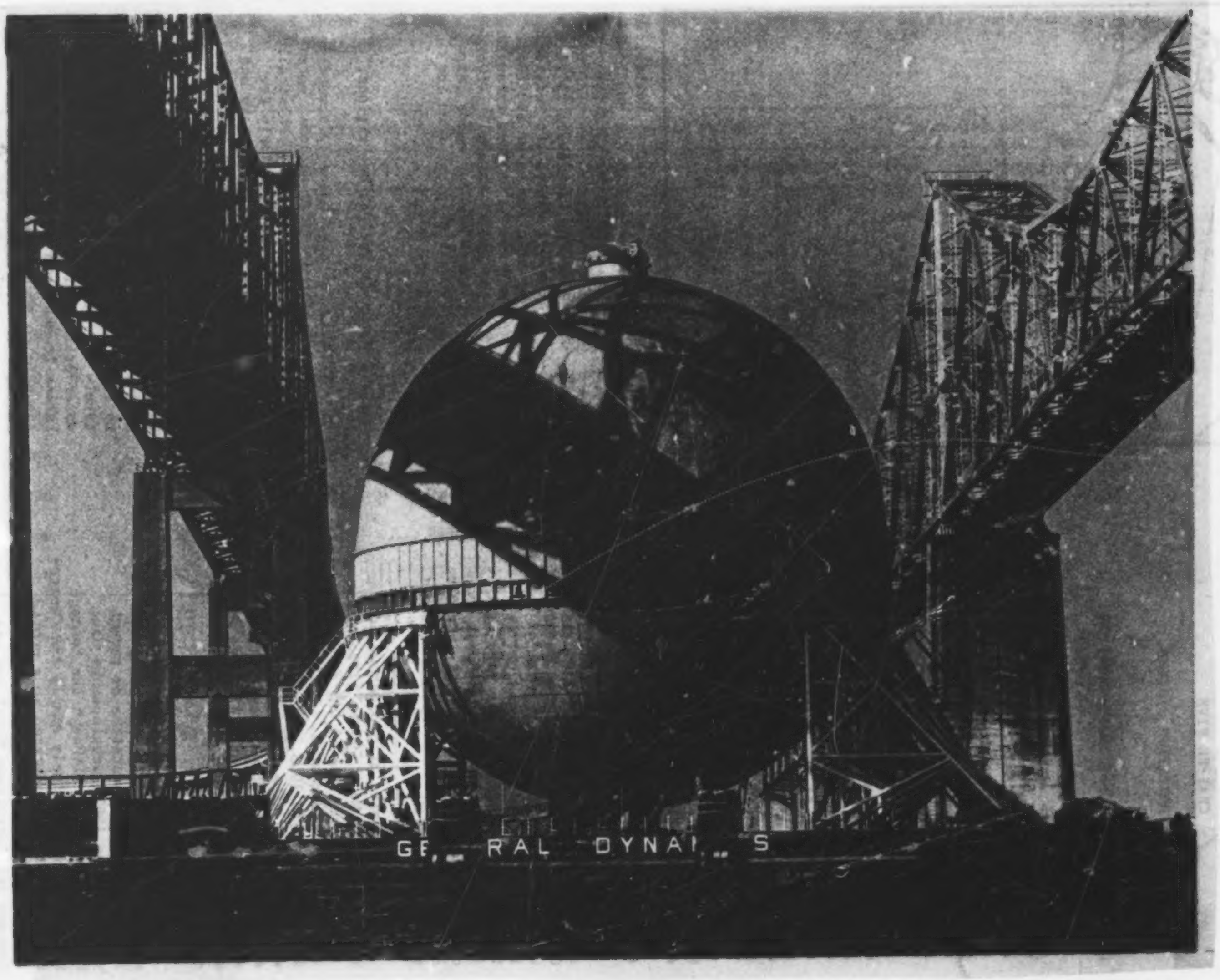

Figure 4-4. Liquefied natural gas container passing beneath the Cooper River Bridges, Charleston Harbor, enroute to Quincy, Massachusetts (photo courtesy News & Courier).

CHAPTER FIVE

TRANSPORTATION SYSTEMS

I. WATERBORNE TRANSPORTATION

Port facilities located in the study area are a vital link in the commercial trade network of both South Carolina and Georgia (Fig. 5-1). In addition to their transportation value, these ports provide a major contribution to the employment and economic stability in the communities in which they are located (Table 5-1). Major coastal ports in the study area include Georgetown, Charleston, Savannah, and Brunswick (Atlas plates 28 - 30). (See also Volume I, Chapter Six for historical trends and present controlling depths of the aforementioned ports.) The Atlantic Intracoastal Waterway provides a sheltered coastal passage for commercial and recreational boats. In addition, limited cargo, mostly industrial goods, is transported down the Waccamaw, Great Pee Dee, Cooper, Savannah, Altamaha, Satilla, and St. Marys rivers.

A. THE PORT OF GEORGETOWN

The port facility at Georgetown and the Intracoastal Waterway provide Georgetown County with a major economic asset. The industrial potential of these facilities is substantial and has yet to be fully realized. Their potential is not unlimited, however, and must be carefully developed if the best interests of the community are to be on a long-term basis.

The State pier at Georgetown is a modern terminal with 500 ft (152.4 m) of berthing space and 60,000 ft^2 (5,574 m^2) of transit shed area. Rail service is available. In 1968, a tanker terminal was added, with pipe connections to a storage-tank farm, thus freeing the dock and transit shed for general cargo movements. Containerization facilities are not available.

Table 5-2 lists the import, export, and domestic tonnage by commodity for 1974, and is representative of recent years. Since 1967, developments have been encouraging. Although the tonnage has remained relatively small, the Georgetown facility has operated at a profit in recent years and International Paper Company and Georgetown Steel now use the facility.

Two factors favor the continued development of Georgetown's port facility and related economic expansion: 1) Georgetown is located on the Intracoastal Waterway and therefore enjoys water access to the larger Port of Charleston, and 2) Georgetown serves as the port facility for the Waccamaw and Pee Dee regions.

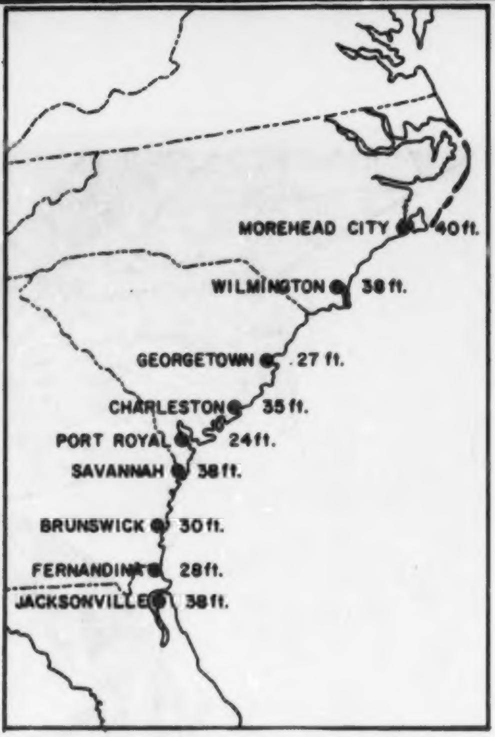

Figure 5-1. Major ship-channel authorized project depths for South Atlantic ports (Chatham County-Savannah Metropolitan Planning Commission 1972). Channel depths are referenced to mean low water and they may not be uniform throughout the entire channel. Figures listed are for major ship channels inland from the outer bar.

Certain factors, however, severely limit the water-oriented economic potential of the Georgetown port. Physically, the port is small and relatively few vessels can be accommodated at any one time. The cost of enlarging the facility would be prohibitive. Little space is available for expansion of port facilities. This lack of space prohibits containerized operations on a large scale. Much of the water-front acreage is devoted to residential and commercial use. Relatively few desirable sites remain for water-oriented industry. Surface transportation to and from Georgetown is not adequate to accommodate heavy cargo movements.

The analysis of assets and liabilities leads to only one logical alternative. Georgetown does not seek to compete with Charleston as a major cargo port; instead, it seeks to attract water-oriented and affiliated industries. The County has taken measures to preserve prime industrial tracts from further encroachment and actively seeks to improve surface and air transportation facilities.

Table 5-1. Freight traffic in thousands of short tons and number of passengers in the harbors of South Carolina and Georgia, 1967 - 1976 (U.S. Army Corps of Engineers 1976).

	Georgetown Harbor		Charleston Harbor		Savannah Harbor		Brunswick Harbor	
	Tons	Passengers	Tons	Passengers	Tons	Passengers	Tons	Passengers
1967	1,168	39	5,565	220,845	4,781	-----	980	-----
1968	1,252	-----	6,390	237,676	6,025	-----	1,011	-----
1969	1,266	5	6,044	192,567	5,801	-----	1,087	15
1970	1,173	7	6,875	261,169	6,811	243	1,053	39
1971	1,191	40	6,946	254,533	7,232	-----	1,059	72
1972	1,524	6,252	7,477	262,554	8,037	752	1,263	135
1973	1,486	500	9,380	258,474	8,980	129	1,394	161
1974	1,620	422	8,993	234,169	9,699	29,780	1,966	118
1975	1,360	242	8,380	295,399	7,593	78,001	1,430	238
1976	1,666	136	9,665	314,675	9,188	74,216	1,686	38,409

Table 5-2. Exports and imports (expressed in short tons) through the Port of Georgetown in 1974 (U.S. Army Corps of Engineers 1974).

Commodity	Total	Foreign Imports	Foreign Exports	Domestic Receipts (Coastwise)	Domestic Shipments (Coastwise)	Domestic Receipts (Internal)	Domestic Shipments (Internal)
Fresh fish, except shellfish	10	-	-	-	-	10	-
Shellfish, except prepared	864	-	-	530	-	334	-
Iron ore and concentrates	339,602	71,602	-	10,000	-	258,000	-
Aluminum ores, concentrates	8,060	8,060	-	-	-	-	-
Manganese ores, concentrates	2,797	-	-	2,797	-	-	-
Grain mill products	2	-	2	-	-	-	-
Alcoholic beverages	3	3	-	-	-	-	-
Tobacco manufactures	52	-	52	-	-	-	-
Basic textile products	12	-	12	-	-	-	-
Pulpwood, log	574,567	-	-	-	-	574,567	-
Wood chips, staves, moldings	31	31	-	-	-	-	-
Lumber	182	-	-	-	-	-	182
Furniture and fixtures	1	1	-	-	-	-	-
Paper and paperboard	88,662	-	88,662	-	-	-	-
Pulp and paper products	4,583	-	1	-	-	-	4,582
Basic chemicals and prod.	143	-	143	-	-	-	-
Drugs	5	-	5	-	-	-	-
Paints	5,440	-	-	-	5,440	-	-
Miscellaneous chemical prod.	6	-	6	-	-	-	-
Distillate fuel oil	13,783	-	-	12,415	-	1,368	-
Residual fuel oil	378,089	89,410	-	286,064	-	2,615	-
Iron and steel primary forms	81,864	-	78,264	-	-	-	3,600
Iron, steel shapes, exc. sheet	108,308	-	91,136	-	14,392	-	2,780
Iron and steel pipe and tube	2	-	2	-	-	-	-
Ferroalloys	1,344	1,344	-	-	-	-	-
Iron and steel products	697	-	697	-	-	-	-
Aluminum and alloys, unworked	73	-	73	-	-	-	-
Machinery, except electrical	439	-	179	-	-	230	30
Electrical mach. and equip.	104	71	33	-	-	-	-
Motor vehicles, parts, equip.	25	-	25	-	-	-	-
Ships and boats	67	-	-	-	-	67	-
Iron and steel scrap	6,568	-	1,058	5,510	-	-	-
Paper waste and scrap	3,356	-	3,356	-	-	-	-
Commodities	245	-	-	-	-	245	-
TOTAL	1,619,986	170,522	263,706	317,316	19,832	837,436	11,174

Total Ton-Miles 18,446,224

B. THE PORT OF CHARLESTON

Charleston's port facilities, like most seaports, are generally made up of two rather different components. The first component encompasses those facilities controlled and operated by the Ports Authority. These facilities can be used by virtually any shipper, and the Ports Authority derives revenue from this use. The second component is comprised of facilities owned and operated by individual private corporations for their exclusive use. Examples of this latter type are oil refineries and bulk terminals, iron and steel mills, and pulp and paper mills. There is, in addition, a third component at the port which is not often found in other places, i.e., facilities owned and operated by the Federal Government.

While the first two components form the basic port structure, Charleston's port has one other arrangement which is also of some importance. This is the leasing of certain Ports Authority facilities to commercial interests for their exclusive use. An example is the facility used by one of the major growers and distributors of bananas for their importations from Central America.

While the Port of Charleston serves primarily the State of South Carolina, important origins and destinations for goods passing through the port are also located in North Carolina, Georgia, Kentucky, and Tennessee. Within South Carolina, the most important area served (measured by value of products) is the inland industrial area centered around Greenville and Spartanburg. The second most important locality served (and the most important in terms of tonnage) is the Charleston area itself, which includes several concerns that own their own port facilities.

The existing South Carolina Ports Authority facilities are located at Union Pier, Columbus Street Terminal, and the North Charleston Terminal. New construction amounting to several million dollars is currently underway at a fourth area - the Wando Terminal.

The State Ports Authority purchased a 561 acre (227.0 ha) tract along the east side of the Wando River in Charleston County to further expand port facilities. The tract has a 2,850 ft (869.2 m) frontage on the river, with depths exceeding the 35 ft (10.7 m) presently maintained in Charleston Harbor.

This $1.5 million tract, almost 80% of which is on high ground, is located across the Cooper River from the State Ports Authority's present facilities. The land acquisition is expected to culminate in an expansion of port facilities which will eventually provide seven new berths for ocean-going freighters. Engineering studies, including aerial and land surveys, have been undertaken, and construction of the first three berths is underway. The site contains 3,500 additional linear feet on a tidal creek on the north side, where the other four berths are planned for development. Proposed 45 ft (13.7 m) channel depths will accommodate the largest container and break-bulk ships projected for the future. The Wando development could ultimately reach an investment of $65 million or more.

Cargo shipped through the Port of Charleston has grown throughout the 1960's and 1970's. Table 5-3 lists major products shipped through the port during 1968 and 1972. Table 5-4 summarizes statewide totals of exports and imports for 1963, 1968, and 1970, and offers projections for 1980 and 1990 shipments through South Carolina ports.

C. THE PORT OF SAVANNAH

Savannah Harbor is located on the lower 21.3 mi (24.3 km) of the Savannah River. The deepwater entrance from the ocean to the central harbor area is through a 22 mi (35.4 km) dredged channel. Port facilities are located on the south bank of the channel from a point 3 mi (4.8 km) below the foot of Bull Street in downtown Savannah to approximately 7 mi (11.3 km) above the foot of Bull Street, and on Hutchinson Island.

Fifty-one piers, wharves, and commercial docks are located adjacent to the Port of Savannah. Twelve of the docks handle general cargo. Nine of the docks and wharves are equipped to receive or ship petroleum products (Table 5-5).

Warehouses with a total of 1,733,200 ft^2 (161,014.3 m^2) of dry storage space and 970,374 ft^3 (27,481.0 m^3) of cold storage space are operated by eight companies and the Georgia Ports Authority. All of the warehouse areas are served by both rail and highway transportation (U.S. Army Corps of Engineers 1972). An estimated 60% of the goods handled through the Port of Savannah are transported by truck and 40% by rail. Tonnage figures from 1963 to 1973 for all waterborne commerce in Georgia are shown in Table 5-6. During this 10-year period, Savannah Harbor experienced its greatest increase in traffic (greater than 50%). In 1973, an estimated 9,500,000 short tons of freight passed through the Port of Savannah. This is a 131% increase from 1963 when 4,110,786 short tons of traffic were handled (U.S. Army Corps of Engineers 1973).

Table 5-3. Major commodities and products shipped through the Port of Charleston, 1968 and 1972 (expressed in short tons) (South Carolina State Ports Authority 1972).

Commodity	Tons of Commodities 1968	Tons of Commodities 1972
Exports		
Grain	347,601	164,820
Iron and Steel Scrap	36,769	1,697
Woodpulp	137,570	104,670
Paper and Paperboard	46,055	251,506
Textiles, Fibers, and Waste	100,516	104,381
Chemicals	73,468	47,717
Imports		
Petroleum	378,935	486,771
Bananas	66,896	134,838
Frozen Meats	64,544	16,501
Textiles, Fibers, Waste	105,328	165,919
Forest Products and Veneer	115,752	239,581
Newsprint	29,949	36,162
Iron and Steel	221,626	125,580

Table 5-4. Exports and imports, expressed in thousands of short tons, moved through South Carolina State ports in 1963, 1968, and 1970, with projections for 1980 and 1990 (South Carolina State Ports Authority 1972).

Cargo Type	1963	1968	1970	1980	1990
Exports					
Bulk	221	495	448	1,010	1,050
General Cargo	227	550	650	1,236	1,865
Sub-total	508	1,044	1,098	2,255	2,915
Imports					
Bulk	337	502	619	854	1,156
General Cargo	434	754	568	1,484	2,355
Sub-total	771	1,256	1,187	2,338	3,511
TOTAL	1,279	2,300	2,285	4,593	6,426

Table 5-5. Piers, wharves, and commercial docks and purpose for which they are utilized in the Port of Savannah (U.S. Army Corps of Engineers 1972).

Primary Purpose for Which Used	No. of Piers, wharves, or docks
Cargo handling:	
Asphalt, bulk cement, gypsum rock, paperboard, liquid sulphur, and liquid sugar (one each)	6
Dry bulk materials	2
General cargo: in foreign and domestic trades	12
Gypsum rock, bauxite, and asphalt	1
Linerboard	1
Lumber and plywood	1
Petroleum products, petrochemicals, asphalt, crude oil, and caustic soda	9
Raw sugar and molasses	1
Sand	2
Timber, creosote, and treated piling, poles, and railroad ties	1
Landing for passenger harbor sightseeing and excursion boats	2
Marine services and repairs:	
Mooring	6
Mooring in connection with marine repair, conversion, and outfitting	6
Not used for handling waterborne commerce	1
TOTAL	51

Table 5-6. Ten year summary of all waterborne freight (in short tons) transported in Georgia, by major water course (U.S Army Corps of Engineers, 1977, Savannah District, Savannah, unpubl. data).

Calendar Year	Savannah Harbor, Georgia	Brunswick Harbor, Georgia	Atlantic Intra-Coastal Water-Way, (Savannah District)	Savannah River Below Augusta, Georgia	Altamaha, Oconee, & Ocmulgee[a] rivers, Ga.	Darien Harbor, Georgia	St. Marys River, Ga. - Fla.	Satilla River, Georgia
1963	4,110,786	964,233	1,030,400	81,290	17,144	841	147,198	2,597
1964	4,157,537	947,094	1,157,952	46,260	22,274	709	153,018	-[b]
1965	4,452,282	857,589	1,085,110	59,983	31,303	853	156,466	-[b]
1966	4,756,663	870,557	1,076,476	57,351	23,463	317	161,339	-[b]
1967	4,780,642	979,859	1,198,289	95,956	23,463	3,705	153,203	300
1968	6,025,457	1,010,879	1,331,547	88,951	22,751	588	167,300	385
1969	5,800,527	1,086,633	912,728	109,423	12,077	1,023	185,161	371
1970	6,810,770	1,053,177	1,004,412	135,574	30,610	5,011	174,418	-[b]
1971	7,231,944	1,059,104	1,018,192	66,446	30,579	345	186,506	-[b]
1972	8,037,171	1,263,086	1,352,763	51,936	6,518	1,832	201,205	-[b]
1973	8,980,201	1,393,653	1,235,784	13,275	11,300	424	192,216	500

a. No commerce for period 1963 through 1973 on Oconee or Ocmulgee rivers. Primary use is for recreational boating.

b. No commerce reported.

Annual growth rates also reflect Savannah's port expansion. In the 1960's, the port recorded a 4.6% annual growth rate, as compared with 3.4% for the Nation as a whole. In the 1970 - 1972 period, the national growth rate declined to 2.8%, while the Savannah rate increased dramatically to 8.6% per year (Clifton and Edens 1973).

The types of goods received and shipped through Savannah Harbor vary from year to year, reflecting national and international economic trends. The 20 major types of cargo handled in 1972 are listed in Table 5-7. A wide variety of types of products are shipped through the port. A total of 74% of the cargo handled in Savannah in 1972 was bulk cargo (cargo loaded and carried without wrappers or containers) (Clifton and Edens 1973).

The major harbor-related port development in Savannah is located on the south side of the river (Georgia side). Lands adjacent to the waterfront on the south bank of the channel are used for commercial and industrial purposes. The central city area and the area farther upriver near the Georgia Ports Authority's Garden City facilities are the areas most intensively used for waterborne commerce. Space is currently available for docks, terminal facilities, and industries requiring a waterfront location (Georgia Department of Natural Resources 1975a).

The north side of the Savannah River and Harbor (South Carolina side) is virtually undeveloped. Except for the Savannah National Wildlife Refuge and several old plantations, lands on the north side adjacent to the river are being used as dredge spoil disposal sites (U.S. Army Corps of Engineers 1975b) (Atlas plates 15 and 16). Development on the north side of the river has been limited by the low-lying marshlands and by the lack of easy access by land to the City of Savannah.

Fort Pulaski National Monument and Fort Jackson State Historic Site are located along the south shore of the Savannah River ship channel near the harbor entrance. The Savannah National Wildlife Refuge, including the Savannah River and surrounding freshwater marshes, is located at the upper end of the autho-

Table 5-7. List of 20 major commodities and products (short tons) shipped through the Port of Savannah in 1972 (U.S. Army Corps of Engineers 1973).

Commodity	Short Tons
Residual fuel oil	2,466,357
Gasoline	733,360
Limestone	672,748
Clay	607,227
Distillated fuel oil	559,553
Building cement	380,867
Pulp	282,746
Paper and pulpwood	275,300
Basic textile products	213,729
Iron, steel shapes, except sheet	200,856
Sodium hydroxide	164,158
Sulphur, liquid	154,313
Coke, pet asphalts, solvents	131,061
Iron and steel plates, sheets	116,854
Naphtha, petroleum solvents	112,411
Veneer, plywood, worked wood	93,545
Vegetable oils, margarine, shortening	87,465
Basic chemicals and products[a]	81,596
Nonferrous metal scrap	78,867
Gum and wood chemicals	72,869
All other	1,494,319
TOTAL	8,980,201

a. Not classified elsewhere.

rized harbor area. These important natural and historical sites may create conflicts in the future if harbor or related industrial expansion is needed.

The City of Savannah is currently developing the downtown waterfront into a tourist and "specialty-commercial" center. Factors Walk, the former center of cotton shipping, has been developed into an unusual complex of small specialty shops and restaurants. Small docks for recreational boating are available to accommodate boaters who wish to dock for short-term shopping or visiting. If navigation rules and regulations are followed, it is not expected that navigation and limited recreational use of the Savannah Harbor will conflict.

D. THE PORT OF BRUNSWICK

Waterfront facilities in the Port of Brunswick include 19 piers, wharves, and docks. The primary purpose of five of the docks is seafood handling; eight docks also provide mooring for marine services and repairs (Table 5-8). Four of these facilities are equipped to receive or ship petroleum products. There is no public warehouse space available in Brunswick, although there are two transit sheds located at the Georgia Ports Authority's Brunswick State Docks that are available short-term general cargo storage. These sheds have 90,910 ft^2 (8378.7 m^2) of storage area and are served by rail and road facilities. Open storage area behind these sheds is available from the Georgia Ports Authority (U.S. Army Corps of Engineers 1975b).

It is estimated that 50% of the goods handled in the Port of Brunswick are transported to and from the port by rail, and the remaining 50% by road. As shown on Table 5-9, residual fuel oil (especially for the McManus power plant and Brunswick industries), limestone, and salt (used in the chemical industry) comprised approximately three-quarters of all commodities handled in 1973.

Table 5-8. Piers, wharves, or commercial docks and cargo handled in the Port of Brunswick (U.S. Army Corps of Engineers 1972).

Purpose	Number of facilities
Cargo Handling:	
1. Dry bulk commodities a. Bunker C fuel oil b. Gum turpentine	1
2. Fuel oil for plant consumption	2
3. General cargo - foreign and domestic trades a. Dry bulk phosphate	1
4. Salt and liquid caustic soda a. Fuel oil for plant consumption	1
5. Seafood a. Mooring fishing boats b. Fueling fishing boats	5
6. Woodpulp	1
Marine Service and Repair:	
1. Fueling fishing boats, tugs, small vessels	2
2. Mooring	5
3. Mooring fishing boats (marine repair)	1
TOTAL (Wharves, piers, and docks)	19

Table 5-9. List of 20 major commodities and products (short tons) shipped through the Port of Brunswick in 1973 (U.S. Army Corps of Engineers 1973).

Commodity	Short Tons
Residual fuel oil	453,253
Limestone	289,849
Salt	239,851
Pulp	164,062
Distillated fuel oil	77,026
Basic chemicals and products[a]	58,640
Sodium hydroxide	48,750
Gum and wood chemicals	18,654
Fertilizers and materials[a]	11,629
Sand, gravel, crushed rock	11,363
Logs	3,844
Iron and steel plates, sheets	3,021
Sulphuric acid	2,700
Timber, posts, poles, piling	2,560
Machinery, except electrical	2,080
Glass and glass products	1,351
Paper and paperboard	1,268
Oilseeds[a]	718
Grain mill products[a]	624
Ships and boats	294
All other	2,117
TOTAL	1,393,653

a. Not classified elsewhere

A total of 85% of the cargo handled in the Port of Brunswick in 1972 was bulk cargo (Clifton and Edens 1973).

An estimated 1,600,000 short tons of cargo were received in Brunswick Harbor in 1973. This figure is a 66% increase from calendar year 1963, when 954,233 short tons were handled. Although this is a strong percentage increase, it is less than that experienced by the Port of Savannah during the same period of time. During the decade of the 1960's, the annual rate of increase was also less than the national port growth rate of 3%. In the 1970 - 1972 period, however, the annual growth rate was 9.5%, a figure higher than the Savannah Port during the same period (U.S. Army Corps of Engineers 1973).

Although the Port of Brunswick is much smaller than the Port of Savannah, it serves an important function in the State of Georgia. Brunswick provides an alternate port to Savannah in case of emergency and offers fast service for perishable products.

The 1975 session of the Georgia Legislature appropriated funds for constructing and equipping a general cargo facility at Colonels Island in the Brunswick Harbor. By improving and developing additional facilities on the island, it is hoped that additional port-related industries will locate in Brunswick. Unlike Savannah Harbor, Brunswick harbor includes a variety of uses in proximity to each other. Commercial fishing docks are located adjacent to commercial shipping docks. Harbor waterfront usage is not intense, although additional fishing-dock space is needed.

An urban renewal plan for the central waterfront area will soon be implemented to further combine land and water uses. In order to encourage a revitalization of the downtown area, vacant land will be developed into a combined residential and community commercial center, including recreational marinas. Because of their need for additional dock space, fishermen have urged the reuse of the area for commercial fishing and industry. City officials, however, have favored the residential/commercial plan.

E. KINGS BAY

This port is a military installation and, as such, is briefly described in the Atlas (Atlas plate 3). Because of its newness to Camden County, Georgia, the facility deserves special attention due to the projected economic and social impact, especially to the towns of St. Marys, Kingsland, and Woodbine.

As previously described, Camden County has in the past been highly dependent upon the pulp and paper industry for its economic base. This economic base has changed and is continuing to change because of the selection of Kings Bay as the East Coast Fleet Ballistic Missile Submarine Refit Site. The introduction of this large facility creates wide-ranging offbase impacts. A study directed by the Kings Bay Steering Committee, completed in May 1979, provides a brief description of offbase impacts and recommendations for solutions to problems that may be created by this rapid growth in Camden County (Kings Bay Steering Committee 1979).

The major impact of the facility on the area, one that can create other impacts, is the increase in population. Table 5-10 contains present population estimates and future projections for Camden County. From 1978 - 2000, St. Marys' population is expected to increase by 157%, Kingland's population by 125%, and Woodbine's by 65%. This increase in population will require growth of all required services, e.g., sewage, housing, police, etc. An enumeration of all projected impacts associated with Kings Bay is found in the Kings Bay Economic Adjustment Plan (Kings Bay Steering Committee 1979).

F. INTRACOASTAL WATERWAY

The Intracoastal Waterway (IWW) provides a continuous sheltered route for commercial and recreational traffic along the eastern and Gulf seaboard from New England to Texas. In the event of war, this water course will be invaluable as a protected intrastate shipping lane. Largely a natural channel, the IWW is the "oldest road in the United States." The Atlantic Intracoastal Waterway (AIWW), the channel on the Atlantic coast, supports commerce on the Atlantic coast, and is an important route for recreational boating. The authorized project depth of the waterway is 12 ft. (3.7 m). For a detailed account of the construction history of the AIWW and its maintenance dredging requirements for South Carolina and Georgia, consult Volume I, Chapter Six. (See also Atlas plates 28 - 30).

The freight traffic movements on the AIWW in the Charleston and Savannah district are shown in Table 5-11. As shown in the table, tnere was no marked difference in annual freight traffic between 1967 and 1976.

G. INLAND WATERWAYS

Inland waterways in the study area include the Waccamaw, Great Pee Dee, Cooper, Santee, Savannah, Altamaha, Satilla, and St. Marys rivers, as well as

Table 5-10. Revised population projections for Camden County (1978 - 2000)[a] as a result of the Kings Bay naval installation (Kings Bay Steering Committee 1979).

City/Area	1978	1979	1980	1985	1990	1995	2000
Woodbine	1,075	1,230	1,259	1,388	1,504	1,633	1,778
Kingsland	2,015	2,791	2,936	3,580	4,160	4,809	5,533
St. Marys	3,568	4,810	5,042	6,074	7,002	8,036	9,195
Unincorporated Camden County	7,282	8,213	8,388	9,168	9,859	10,635	11,503
Total Camden County	13,940	17,043	17,625	20,205	22,525	25,112	28,011

a. Projections based on a comprehensive land use and housing survey of Camden County and the three municipalities, January, 1979.

Table 5-11. Freight traffic, in thousands of short tons, and number of passengers in the Atlantic Intracoastal Waterway of South Carolina and Georgia, 1967 - 1976 (U.S. Army Corps of Engineers 1976).

Year	Charleston District[a]		Savannah District[b]	
	Tons	Passengers	Tons	Passengers
1967	1,420	-	1,198	-
1968	1,580	-	1,324	-
1969	1,621	5	958	5
1970	1,396	13	1,004	7
1971	1,367	70	1,018	40
1972	1,559	13,246	1,352	96
1973	1,614	146	1,236	146
1974	1,593	118	1,232	25,900
1975	1,405	360	901	54,878
1976	1,406	148	1,068	48,470

a. Includes from Little River, South Carolina to Port Royal Sound, South Carolina.

b. Includes from Port Royal Sound, South Carolina to Cumberland Sound, Georgia.

lakes Moultrie and Marion. They are used on a very insignificant scale for transportation of industrial goods.

II. ROADS AND HIGHWAYS

Roads and highways play a major role in shaping the growth patterns of the Sea Island Coastal Region, as they do in other parts of the State. The motor vehicle is the primary mover of people and goods, and access to and from the roadway network is a key factor in the economic growth of a community.

The number of highways in the coastal counties of South Carolina and Georgia is adequate for present usage. However, the highway quality needs improvement. A very large percentage is a narrow two-lane highway with poor alignment. The highway corridors and proposed improvements required for each major and secondary system were identified by Wilbur Smith and Associates in the Regional Transportation Study prepared for the Coastal Plains Regional Commission in 1969.

Tables 5-12 and 5-13 show highway system mileage summaries for coastal counties of Georgia and South Carolina, respectively. Almost all coastal counties in Georgia depend largely on county roads for highway transportation.

The construction, operation, and maintenance of a roadway involve engineering and construction activities which may have direct negative environmental impacts if not properly managed. First and foremost is location of the roadbed itself, which may be routed along or through sensitive wetland areas or water bodies. The primary concern is destruction or significant deterioration of the ecological system, mainly through dredge and fill operations. This is why bridges are preferred in these areas, rather than filling to create roadbeds or embankments which would result in loss of marsh habitat and disruption of water flow or circulation. For a detailed treatment of highway construction and environmental problems, refer to Gosselink et al. (1972).

Also associated with road and highway construction are possible impacts of drainage and sedimentation through land clearing, grading, and slope stabilization. Changes in the natural drainage pattern may increase flooding hazards,

Table 5-12. Highway system mileage summary in the coastal plain counties of Georgia, 31 December 1977 (Georgia Department of Transportation, Planning Data Service Section, 1978, Atlanta, unpubl. data).

County	Interstate	Other State	County Road	Total Miles
Bryan	20.93	86.27	214.01	321.21
Camden	27.28	106.58	258.10	391.96
Chatham	37.16	136.50	468.97	642.63
Effingham	3.46	95.03	477.49	575.98
Glynn	16.66	121.85	286.44	424.95
Liberty	13.06	74.53	183.84	271.43
McIntosh	21.92	70.59	153.08	245.59
TOTAL	140.47	691.35	2,041.93	2,873.75

Table 5-13. Highway system mileage summary in the coastal plain counties of South Carolina, 30 June 1975 (South Carolina State Highway Department 1975).

County	Interstate System	State Primary System	State Secondary System	Total Miles
Beaufort	-	128.93	340.41	469.34
Berkeley	17.55	236.94	591.49	845.98
Charleston	16.75	239.88	756.19	1,012.82
Colleton	28.95	246.47	677.18	952.60
Dorchester	33.01	148.43	467.63	649.07
Georgetown	-	148.18	435.86	584.04
Horry	-	298.33	818.32	1,166.65
Jasper	33.64	168.87	280.63	483.14
TOTAL	129.9	1,616.03	4,367.71	6,163.64

and stormwater runoff may become a problem. Water quality may also be affected due to heavy loads of toxic pollutants and nutrients from the road surface and adjacent embankments if care is not taken in design of roadways to handle stormwater runoff. Of secondary physical importance, but of great economic importance, is the extensive development that occurs at intersections and highway interchanges.

Waterway navigation presents another potential conflict when roads are planned to cross water bodies. Adequate clearance under bridges, rather than causeway construction, can ameliorate this problem.

III. RAILROADS

Railroads are a principal means of transporting industrial, commercial, and agricultural goods to market in the Sea Island Coastal Region. They serve as an important supplement for other transportation modes, for example, linking industrial and manufacturing sites to port facilities. The two major rail systems serving the coastal region are the Southern Railway and the Seaboard Coast Line Railroad.

Southern Railway owns more than 10,000 mi (16,093 km) of track and has its headquarters in Washington, D.C. Similar to other existing railroads, Southern attained its present size through successive mergers of several small independent railroads. Southern's two main routes run from Washington, D.C., to New Orleans, Louisiana. Although these main north-south lines are west of the Sea Island Coastal Region, Southern operates east-west lines from its main lines to Charleston, Savannah, and Brunswick.

The Seaboard Coast Line was formed in 1967 when the Atlantic Coast Line and Seaboard Air Line Railroads merged. It owns over 9,000 miles of track and has its executive headquarters in Jacksonville, Florida. This system serves the region intensively with lines extending to all parts of the region, running both north-south and east-west. The Seaboard also provides service to all major points in Florida, and it extends as far north as Richmond, Virginia, thereby offering a vital connection to the Northeast. A complete list of rail lines serving the Sea Island Coastal Region is presented in Table 5-14. (See also Atlas plates 28 - 30).

While rail use (passenger and freight) has declined in other parts of the Nation, to a large extent the economic importance of railroads in South Carolina and Georgia has been retained. Although passenger service in the region is very limited, the existing rail network has sufficient capacity for freight service to allow for expansion of services, which will be required for accelerated economic growth. Railroads in this coastal region are doing well financially (G. H. Allen, 1979, Seaboard Coast Line, Charleston, pers. comm.). The only plan for new tracks is the 10 mi (16.1 km) stretch from Russelville, South Carolina to Cross, South Carolina that will service the new power plant being built as a result of the Santee River rediversion. No tracks have been abandoned, as other carriers (e.g., Amtrak) are using preexisting rail networks (e.g., Seaboard Coast Line).

The possible negative environmental effects associated with development of new railroads are similar to the impacts of roads and highways. These include:

1) loss of valuable habitats if extensive dredge or fill is required;
2) disruption of water flow and circulation if properly designed bridges or other means to provide circulation are not utilized;
3) degradation of adjacent water quality if storm water runoff and sedimentation are not adequately controlled during construction and operation.

IV. AIR CARRIERS

Air transport is an increasingly important mode for the transportation of passengers and cargo. Airport facilities are generally of coastal management concern only when their construction or expansion may have significant impacts on coastal resources (for example, if extensive encroachment is proposed into productive wetland areas).

In addition to potential direct loss of unique natural habitats or valuable wetlands, the construction and operation of major airport facilities, if not properly managed, might result in water quality degradation due to direct stormwater discharge from paved parking or landing areas or from sedimentation and erosion. The development of adjacent land can pose an additional concern if it is within the noise impact zones.

Most passenger traffic in the coastal area is by air, bus, or passenger cars. No data on bus or private car travel are available. However, air travel plays an increasingly important role in passenger traffic, particularly for longer trips. The air freight services offered are also an important factor in economic development. Travel by private planes is of growing consequence, particularly

Table 5-14. Railroads serving the Southeastern coastal region.

Railroad	Home Office	Mileage of Rail	Services Offered[a] P	F	E	T	Southeastern Coastal States Served
Central of Georgia	Savannah, Georgia	1,743	X	X		X	Georgia
Seaboard Coast Line	Jacksonville, Florida	9,632	X	X		X	Florida, Georgia, South Carolina, Virginia
Southern Railway Company	Washington, D.C.	10,250	X	X		X	D.C., Florida, Georgia, North Carolina, South Carolina, Virginia
Amtrak	Washington, D.C.	[b]	X		X		D.C., Virginia, North Carolina, South Carolina, Georgia, Florida
Auto-Train, Inc.	Lawton, Virginia	[b]	X[c]				Virginia, Florida

a. P = Passenger, F = Freight, E = Express, T = Trailer on flat car
b. Uses existing rails of other railroads
c. Carries automobiles also

in serving the coastal resorts and as a recreational activity.

There are 31 airports in the Sea Island Coastal Region, of which two (Charleston and Savannah) provide scheduled airline services and are classified as major airports. In addition, there are five military fields. A listing of these airports by county follows in Table 5-15. (See also Atlas plates 28 - 30.) Additional information on airports can be found in Airport Activity Statistics by the Civil Aeronautics Board and Federal Aviation Administration (1975). Although outside the study area, the Jacksonville, Florida, airport is a major airport that services the Sea Island Coastal Region. Scheduled air service is also available from Myrtle Beach, Horry County, South Carolina.

V. PIPELINES

An important segment of the modern transportation complex is the pipeline system. The availability of natural gas is a particularly important factor in facilitating industrial development. The system of pipelines serving and traversing the coastal areas of South Carolina and Georgia is depicted on Atlas plates 28 - 30.

Natural gas is the only product moved by pipeline in the study area. The area is serviced by the Carolina Pipeline Company and South Carolina Electric and Gas Company.

Table 5-15. Airports in the Sea Island Coastal Region (Planners Inc. 1974).

Location	Non-Commercial	Commercial	Military
South Carolina			
Jasper County	1	-	-
Beaufort County	3	-	1
Berkeley County	1	-	-
Charleston County	5	1 Charleston	1 (same as city airport)
Colleton County	1	-	-
Georgetown County	-	-	-
Horry County	2	-	-
Georgia			
Camden County	2	-	-
Glynn County	3	1 St. Simons	1
McIntosh County	4	-	-
Liberty County	2	-	1
Bryan County	-	-	-
Chatham County	1	1 Savannah	1

CHAPTER SIX

AGRICULTURAL DEVELOPMENT

I. HISTORICAL TRENDS

Although subsistence agriculture was begun almost at once upon the settlement of South Carolina in 1670 and the establishment of Georgia in 1733, it was several years before the great staple crops of indigo, rice, and cotton were developed and expanded to important export status.

Early European settlements in the South were located in regions where the Indians were involved in the cultivation of particularly important native crops: corn, tobacco, and sweet potatoes (Gray 1941). Corn (maize) was utilized extensively by the Indians and colonists. Other than corn, no important native grain crop was adapted into Colonial agriculture. Although important as a domestic food and exported for several years, corn was never valued as a major export crop.

Although it was initially intended that cotton, indigo, and rice were to be among the principal crops, they were apparently first tried with little success. For years, the major agricultural export from the Sea Island Coastal Region was wood products of the class known as naval stores. Later, cotton and tidewater rice culture would dominate agriculture of this region.

A. NAVAL STORES

Vast forests covered South Carolina and Georgia at the time of their discovery. Only extremely limited use of the forests, probably not much beyond personal needs, had been practiced by the early Spanish and French explorers. It was the English colonists of the seventeenth and eighteenth centuries who developed an extensive trade in that class of congeneric wood products known as naval stores, i.e., permanent or consumable supplies for warships excluding armament supplies. These stores, such as tar, pitch, turpentine, and rosin, are products of pine and other coniferous trees.

During the colonial period, lumbering and the production of naval stores were essentially agricultural activities carried on mainly by farmers and planters. However, after the Revolution, the production of naval stores became mainly a woodland occupation and was no longer a plantation industry to any important extent (Gray 1941).

Physical evidence of production operations is difficult to document. The most readily apparent effect was hastening, as a result of agricultural clearing, the destruction of the virgin forest. Of all the methods of producing tar, pitch, and turpentine, only the construction of tar kilns would have left tangible evidence of their existence.

Although naval stores (forest) production steadily declined, it continued in isolated locations in varying degrees to the end of the nineteenth century (Doar 1908). Today, the primary utilization of naval stores is obviously in products other than naval warships (e.g., paint products). In Brunswick, Georgia, Hercules, Inc. is one of the largest producers of naval stores (tar, pitch, turpentine, etc.) in the world today.

B. COTTON

Various conflicting accounts attribute the beginnings of sea island cotton to about the period of the Revolution. These divergent accounts of its introduction appear to suggest that, at about the same time, several individuals on the Georgia coast received samples of sea island cotton seed from the Bahama Islands (Gray 1941). Sea island cotton may have been grown on St. Simons Island, and possibly Sapelo Island, as early as 1778. At approximately the same time, it appeared on Cumberland Island. Its cultivation soon spread, but the Revolutionary War temporarily hindered its development as a commercial enterprise.

Sea island cotton was essentially different in length and quality from short-staple cotton and was utilized for relatively distinct purposes. The sea island product was long-staple, high-quality, and similar to Egyptian cotton, for which the English textile mills had a great demand. The textile industry became highly intensive, with emphasis on quality, rather than quantity, which was characteristic of the production of the short-staple varieties.

Sea island cotton, in contrast to the short-staple variety, was narrowly restricted in geographic area. After the early period, there was little increase in area or volume of production. The best quality of sea island cotton was recognized to be grown on the coastal islands. The bulk of the cotton crop was grown either on the islands or on the mainland within 30 mi (48.3 km) of the coast.

Sea island cotton production flourished greatly prior to the Civil War. Thousands of acres of land were cleared and cultivated for cotton production in the Sea Island Coastal Region. Major production areas were centered on the coastal islands and in the major river flood plains in coastal South Carolina and Georgia.

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Cotton production in the Sea Island Coastal Region was greatly reduced after the Civil War, due largely to the loss of the slave labor force and the lack of adequate capital to maintain the large-scale operations.

Although cotton production was reduced after the Civil War, South Carolina sea island cotton regained some prominence, with the center of production of the finest staple being James, Johns, Wadmalaw, and Edisto islands. South Carolina averaged 10,957 bales, at slightly less than 400 lb (181 kg) per bale, for the years 1902 through 1907 (Orton 1907). Georgia produced more than 50,311 bales during the same period; however, it is interesting to note that, with minor exceptions, most of this Georgia sea island cotton was not grown in the coastal counties, much less on the sea islands (Fig. 6-1).

The final blow to the sea island cotton industry was delivered by insect pests. Until the beginning of the twentieth century, the principal insect enemy was the caterpillar or leaf worm. In 1872, they were observed after a 5-year absence and some planters began to consider the " . . . necessity of abandoning the cultivation of the long cotton . . . " (News and Courier Newspaper 1880). However, by 1880, caterpillars were no longer" . . . regarded as a plague which could not be averted . . . " (News and Courier Newspaper 1880).

From Mexico, a new threat appeared, a beetle which fed on the cotton boll itself, for which there was then no practical remedy. The boll weevil crossed the border into Texas in 1890. By 1910, it was in Alabama and in 1918 was effectively destroying the sea island cotton crop in South Carolina and Georgia. Production of the long-staple sea island cotton rapidly declined and finally ceased prior to World War II.

C. RICE

Rice culture was introduced into North America during the last quarter of the seventeenth century in the vicinity of Charleston, South Carolina (Courtney 1884, Doar 1936, Salley 1967). By 1700, rice was being grown in such quantities that the collector of customs at Charleston indicated that available shipping was inadequate to export all of it (Doar 1908). The rice industry expanded into the southeastern part of South Carolina after the settlement of Georgia removed the menance of the Spaniards and Indians. About the same

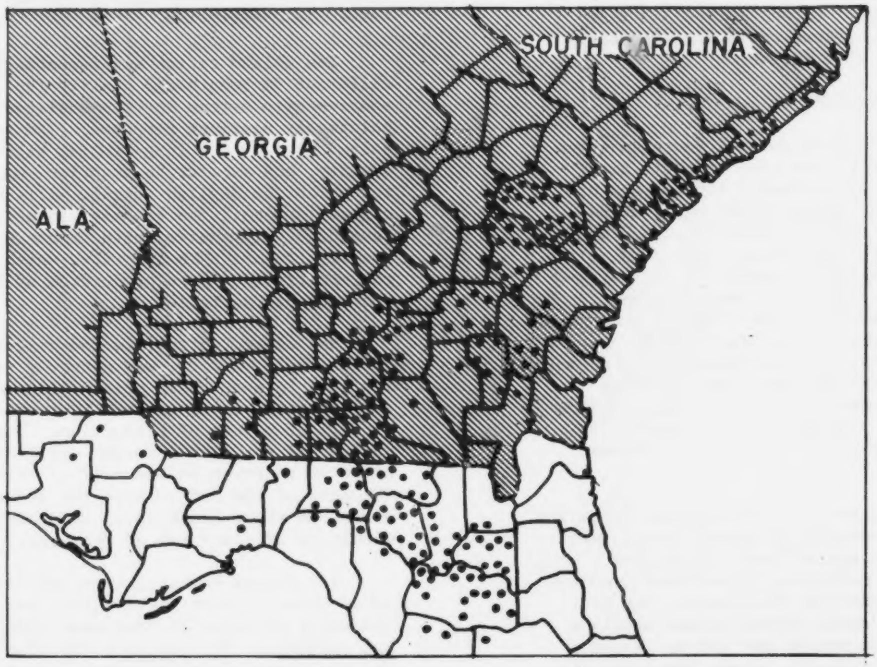

Figure 6-1. Sea island cotton producing areas of South Carolina, Georgia, and Florida, showing production distribution by counties from 1902 - 1907. Each dot stands for an average production of 500 bales (Orton 1907).

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time, the industry also expanded into northeastern sections of the Carolina Province. Rice was at first grown as an upland crop without irrigation; however, it is probable that even the very early colonists recognized the advantage of utilizing low, moist land.

Irrigation is said to have begun about 1724 on the freshwater swamps in the low eastern part of the Province. The swamp bottoms were irrigated by water stored in ponds formed by dams. Drainage was accomplished through ditches into adjacent streams. During this period, water was probably employed only for supplying moisture and not for the systematic destruction of weeds and insects as practiced later. Irrigation systems were not as elaborate or as permanent as they were after the Revolution. Consequently, the industry did not exhibit the great degree of geographic stability which characterized the later period.

Planting continued in the freshwater swamps until the close of the Revolution, although some small transfers of cultivation to the tidewater region had begun earlier. Use of the tidal river swamps is said to have started as early as 1758 on Winyah Bay (Gray 1941). Before 1783, there was considerable use of inland swamps in Georgia. It was asserted that during this period ". . . devastating floods . . ." caused heavy damage to the inland swamp rice fields (Gray 1941). The shift to the tidewater region came during the late eighteenth and early nineteenth centuries. Due primarily to ineffective methods of water control, upland rice was never grown in the large quantities later produced in the tidewater region. The shift to this latter region was induced partly by the grassy condition prevailing in the inland swamp lands, but mostly by the development of the advantageous water culture. Also, as the backcountry was increasingly cleared and cultivated, the problems of unwanted silting and flooding increased. Upland rice fields rapidly developed the condition of too much or too little water at a given time, and the "freshet" became the fear of all planters.

Rapid expansion continued into the tidewater region until the outbreak of the Revolution. Confidence of the merchants had increased and they poured slaves and supplies into the Carolina Province. The relaxation of prohibitions against importing Negro slaves into Georgia, and increased physical security from Spanish intrusion due to the British occupation of Florida, resulted in expansion of the industry into Georgia.

After the Revolution, major developments led to a greater expansion of the industry. About 1786, a system was perfected utilizing tidal action to flood and drain fields. This provided a much greater degree of control than the earlier upland system. Also, Carolina rice had an established reputation for quality and commanded a premium price.

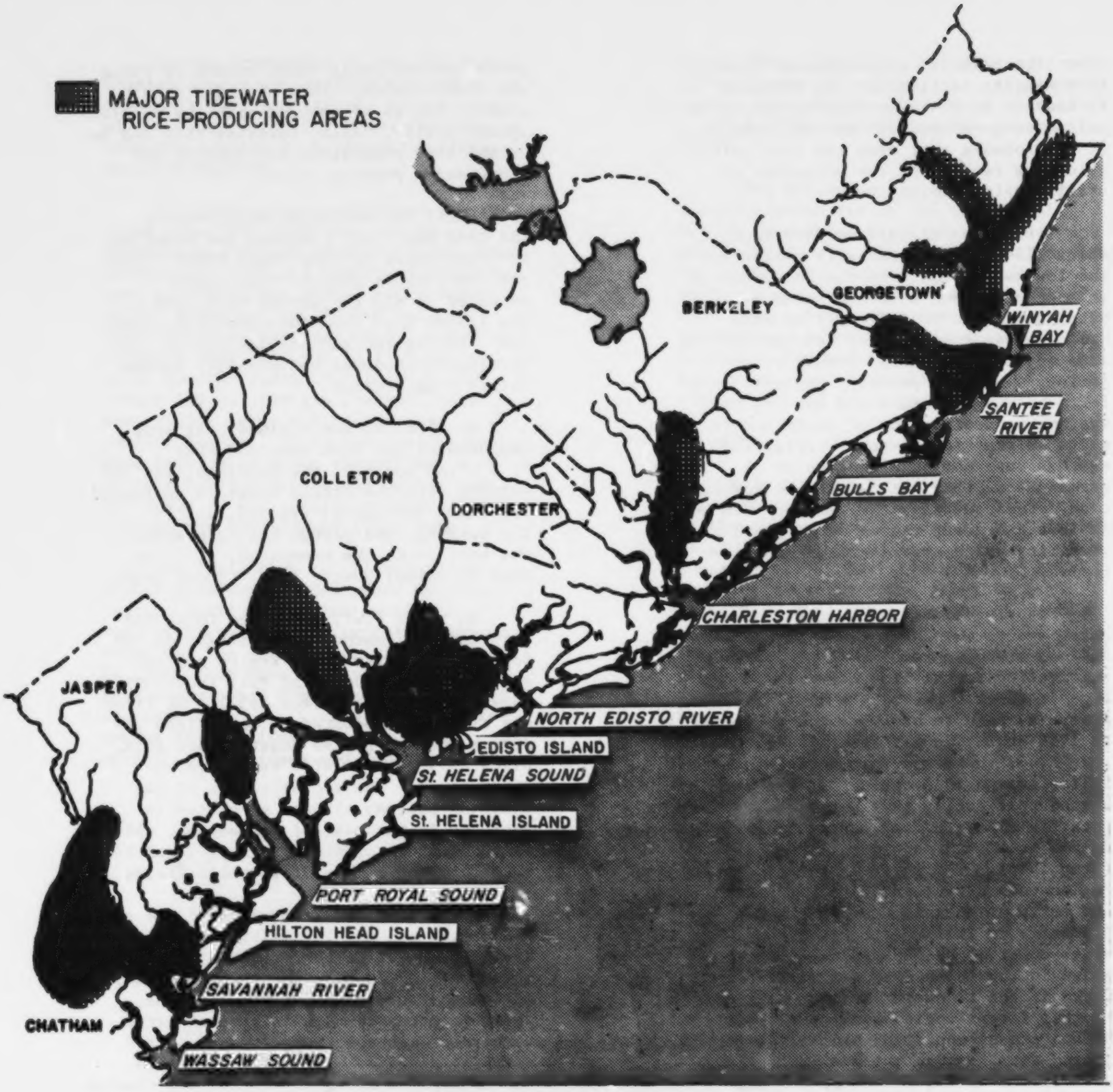
Until the mid-nineteenth century, the land was first prepared for planting by using mules or oxen (Doar 1936). After field hands plowed, they were required to dig the ground with hoes. The fields were then smoothed with a harrow. During the ante-bellum period, cultivation procedures had probably become fairly standardized.

By 1850, it was claimed that some improvement had been made and that ". . . the hoeings, the pickings, and the cutting with the sickle remained unchanged; but lands are better drained, and in the turning, the plough had superseded the hoe; (and) the trenching, . . . is done by animal power; . . ." (Doar 1936).

In about 1787, Johnathan Lucas constructed, at Peachtree Plantation on the South Santee River, the region's first successful rice pounding mill (Courtney 1884, Doar 1936, Wallace 1951). At first the mills were powered by water from reserves such as Blakes Reserve (see Atlas plate 35). Steam later supplemented water power. The mechanization of the pounding process allowed a substantial increase in the rate of processing, which encouraged the planters to expand cultivation to the limits of suitable fields.

In view of the technology of the era, it appears all but impossible that the amount of earth moved for dikes and impoundments could have been accomplished. The expenditure of labor was enormous, which promoted the acquisition of large numbers of slaves. Some areas required years to reclaim. The major rivers in South Carolina along which rice was planted were the Waccamaw, Black, Sampit, Pee Dee, Santee, Cooper, Edisto, Ashepoo, Broad, and Combahee, as well as the Savannah (Fig. 6-2). The most productive areas in Georgia included the Savannah, Ogeechee, Altamaha, Satilla, and St. Marys river valleys (Fig. 6-3). Of all these regions, the Winyah Bay and Santee River areas exhibited the most outstanding production.

Because tidewater rice production was unique and because it has left a lasting impression on the natural systems of the Sea Island Coastal Region, the following description of rice field construction and operation is presented to promote a better understanding of the impacts that this agricultural practice had on the area. Typically, once a location was selected, a temporary ditch and embankment were constructed, and any natural channels running through the embankment were bridged and later filled. "Trunks" were



MAJOR TIDEWATER RICE-PRODUCING AREAS
BERKELEY
GEORGETOWN
WINYAH BAY
SANTEE RIVER
BULLS BAY
COLLETON
DORCHESTER
CHARLESTON HARBOR
JASPER
NORTH EDISTO RIVER
EDISTO ISLAND
St. HELENA SOUND
St. HELENA ISLAND
PORT ROYAL SOUND
HILTON HEAD ISLAND
SAVANNAH RIVER
CHATHAM
WASSAW SOUND

Figure 6-2. Major tidewater rice areas in South Carolina at the close of the nineteenth century (adapted from Hilliard 1975).

installed in the embankment, and the clearing of the swamp began (Heyward 1937). Individual fields were then made by constructing "cross banks" within the large embanked area, which served to keep water in, or out of, each field. Normally, the fields were ditched to aid in drainage. New fields were developed in a sequence of stages sometimes requiring years for completion. After the embankments were completed, flood gates were installed at the ends of trunks, and the field was then ready to be placed into operation. Figure 6-4 illustrates the sequential phases usually required to convert tidal swamp habitat into a functional rice plantation. Figure 6-5 depicts a finalized impoundment arrangement on a large plantation on the Combahee River, South Carolina.

The entire process of clearing, diking, and construction was slow and many years of effort were required to open new fields and place a plantation in proper order. Once a field was placed into production, it required constant attention and maintenance. Moreover, the desired water levels of the fields had to be carefully maintained. Water levels were

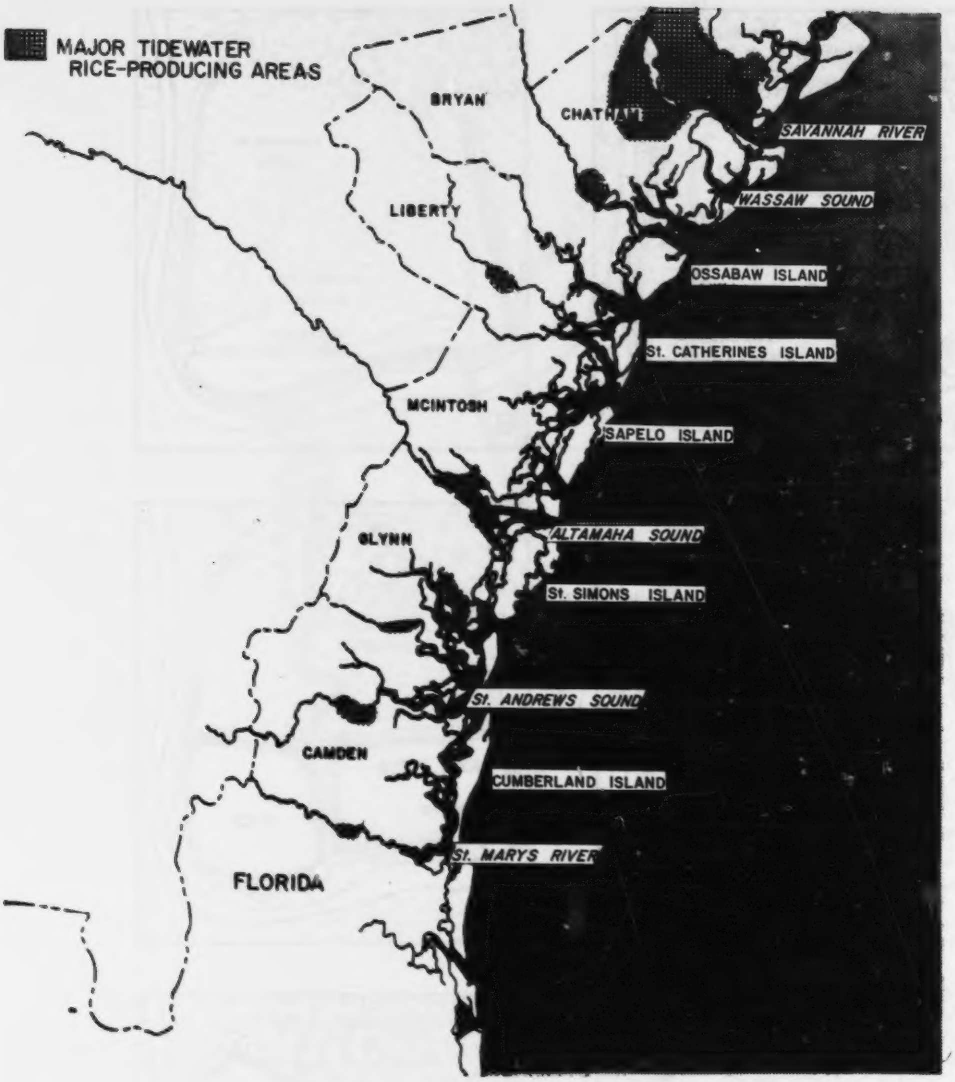

MAJOR TIDEWATER RICE-PRODUCING AREAS
BRYAN
CHATHAM
LIBERTY
MCINTOSH
GLYNN
CAMDEN
FLORIDA
SAVANNAH RIVER
WASSAW SOUND
OSSABAW ISLAND
St. CATHERINES ISLAND
SAPELO ISLAND
ALTAMAHA SOUND
St. SIMONS ISLAND
St. ANDREWS SOUND
CUMBERLAND ISLAND
St. MARYS RIVER

Figure 6-3. Major tidewater rice areas in Georgia at the close of the nineteenth century (adapted from Hilliard 1975).

regulated by the flood gates and trunks. Ideally, the bottom of the trunk was placed at the low tide level. The gates could be locked in position or swung to operate as a one-way valve. During flooding, the outer gate was locked open and the inner gate was opened automatically by tidal pressure through the trunk. When the tide began to fall, water pressure closed the inside gate, thus holding water in the rice field.

The tidewater rice plantation was a complex arrangement and its location and operation raised it to the level of an art. A number of valuable conclusions were drawn by Hilliard (1975) concerning the typical rice plantation: "1) The conditions necessary for tidewater rice culture had to be precise, thus requiring careful attention to location. 2) These conditions were met only in the relatively narrow coastal zone, thus tidewater rice could not expand indefinitely from its core area. 3) The time and labor requirements were substantial, making it unlikely that small farmers with little or no extra-family labor could

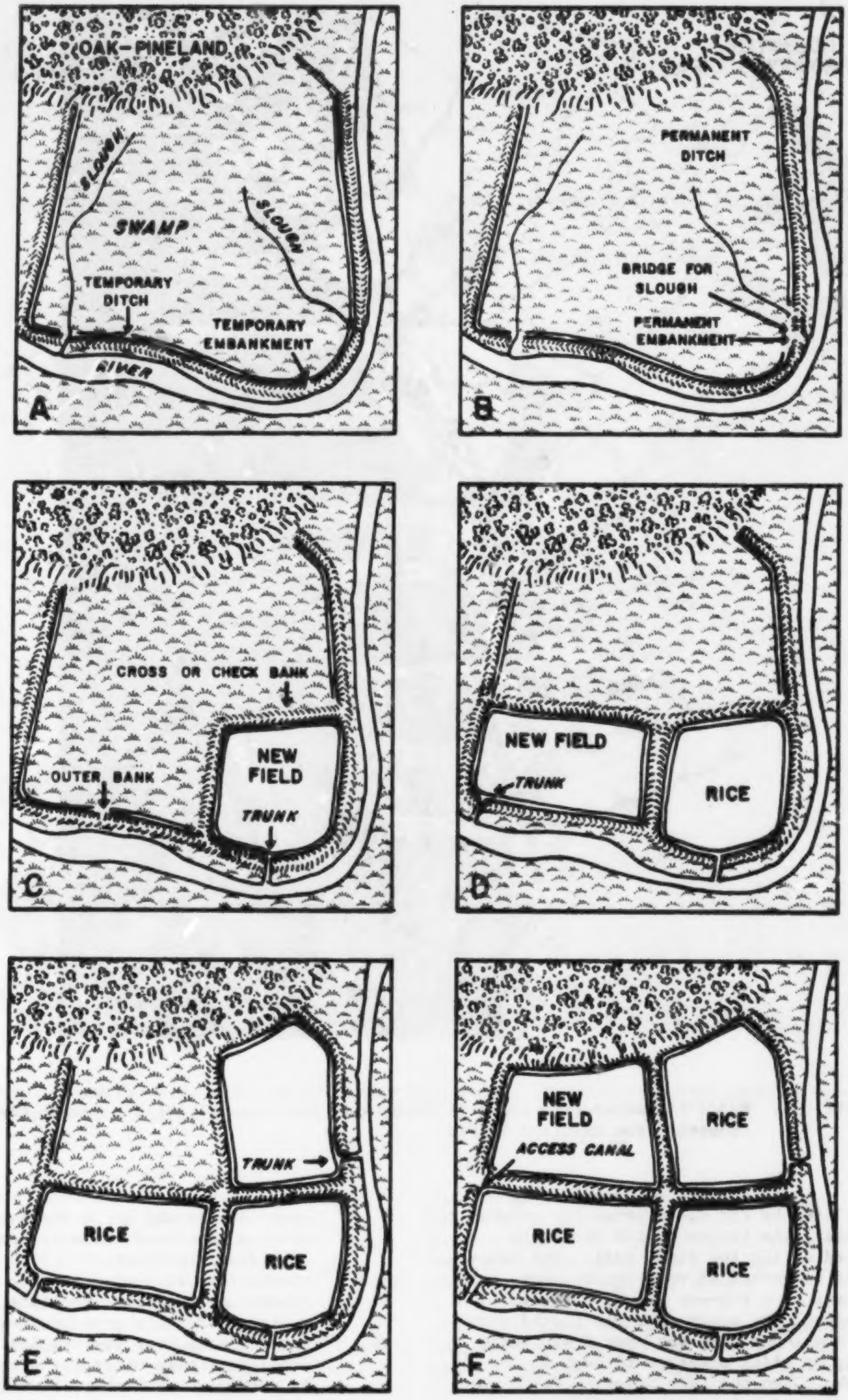

OAK-PINELAND
SLOUGH
SWAMP
SLOUGH
TEMPORARY DITCH
TEMPORARY EMBANKMENT
RIVER
A
PERMANENT DITCH
BRIDGE FOR SLOUGH
PERMANENT EMBANKMENT
B
CROSS OR CHECK BANK
NEW FIELD
OUTER BANK
TRUNK
C
NEW FIELD
TRUNK
RICE
D
TRUNK
RICE
RICE
E
NEW FIELD
RICE
ACCESS CANAL
RICE
RICE
F

Figure 6-4. Sequential views of a hypothetical rice plantation, from initial clearing through several stages, a process sometimes requiring a number of years (adapted from Hilliard 1975).

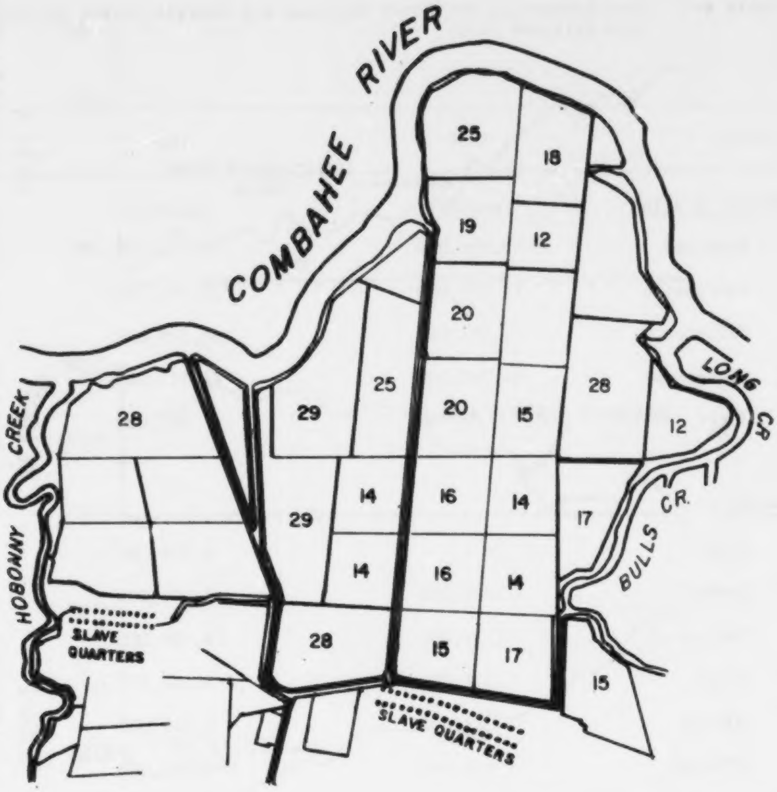


Figure 6-5. A view of a fully developed tidewater rice plantation of the early nineteenth century (Doar 1936).

successfully compete. 4) Knowing the vagaries of coastal environments, with their periodic storms, devastating tides, and occasional freshets from upstream, one can imagine that a substantial amount of maintenance was needed to keep the fields in order. 5) Reclaiming a tidal swamp for a rice field demanded a high level of technical expertise. Leveling embankments, laying off ditches and fields, and setting trunks and gates required considerable engineering knowledge. No other large agricultural regions in the United States during the ante-bellum period demanded such expenditures of labor and such a high degree of technical supervision while bringing land into production."

Georgia and South Carolina produced almost 90% of the total national rice crop during the early nineteenth century. Until 1860, Georgetown, South Carolina was the highest rice producing county in the Nation (Table 6-1). During the period 1850 - 1860, Doar (1936) listed 39 Santee River plantations in operation, having a total of 16,600 acres (6,700 ha) under cultivation. The average annual yield for these plantations was 30 bushels per acre.

After 1860, production faltered and never recovered. The causes for its decline and ultimate extinction were various. The Civil War caused the destruction of some facilities and, more importantly, the loss of slave labor and adequate capital. These were the first great blows to the planters, for without the full control of a stable labor force and with the general shattered condition

Table 6-1. Rice production for South Carolina and Georgia during pre-Civil War years (adapted from Hilliard 1975).

County	1839	1849	1859[a]
South Carolina	(pounds)	(pounds)	(pounds)
Beaufort	5,629,000	47,230,000	18,791,000
Charleston	11,939,000	15,701,000	18,890,000
Colleton	5,483,000	45,309,000	22,839,000
Georgetown	36,360,000	46,765,000	55,805,000
Horry	80,000	485,000	238,000
Georgia			
Bryan	- -	2,409,000	1,610,000
Camden	1,006,000	6,401,000	10,330,000
Chatham	6,159,000	19,454,000	25,934,000
Glynn	1,937,000	3,380,000	4,843,000
Liberty	223,000	1,842,000	2,548,000
McIntosh	2,826,000	3,123,000	6,421,000

a. Data after 1859 showed drastic declines in production for all counties.

of the economy after the Civil War, each storm or other disaster forced curtailment of some production. Later, the final abandonment of commercial rice culture in the South Atlantic States was caused by the introduction of rice into Louisiana and southwestern States on lands where machinery could be used in both cultivation and harvesting. Hand-grown rice was soon priced too high to be competitive and production ceased (Doar 1936).

The rice plantation as a commercial venture lasted only about 200 years; however, at its peak it probably represented the most significant use of the tidewater region for crop agriculture ever attained in the United States (Hilliard 1975). These remnant fields and impoundments of the rice culture have had a tremendous impact on waterfowl management in South Carolina and Georgia. For a discussion of the abandoned rice fields as they relate to present land use practices, consult Chapter Eight of this volume.

II. PRESENT AGRICULTURAL PRACTICES

Until the middle of the twentieth century, the history of land use in the Sea Island Coastal Region represented the history of agriculture. Increases in agricultural output in the coastal plain have traditionally been achieved through an expansion of the cultivated area. However, the last century has seen increases in output per acre yield without additional land being required for cultivation (Fig. 6-6). This has been largely the result of modern technologies in the use of fertilizers, pest control, plant genetics and mechanization of the industry.

Modern agricultural systems have evolved into highly manipulated ecosystems controlled by extensive management. As reflected through history, agriculture systems have developed from solar-based, subsistence systems to highly functional systems based on modern technology. In dealing with agricultural systems of the coastal plain, one can readily perceive the transition from a paleotechnic agricultural system, with predominate human and animal labor, to the neotechnic systems of farming where advanced scientific knowledge is linked to high crop yields (Wolf 1966). The impact of these agricultural systems on productivity and

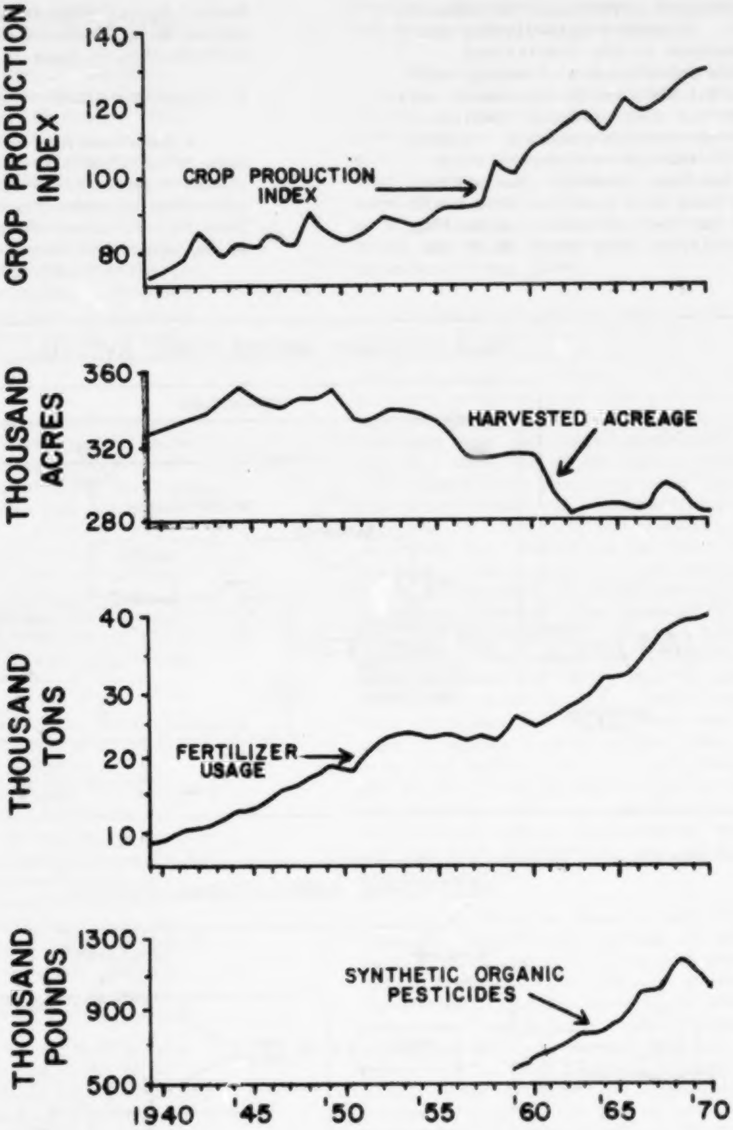


Figure 6-6. Agricultural changes in the United States, 1939 - 1970 (adapted from Manners 1974).

the socioeconomic environment is shown in Figure 6-7. In modern agricultural systems, as opposed to the traditional systems, the introduction of energy subsidies has not only vastly increased crop yields, but has also produced dramatic changes in agriculture practice. Consequently, the related socioeconomic environment has been altered. Man's time and energy have been diverted from basic production to other pursuits. According to Manners (1974), only about 5% of the United States population is directly employed in agriculture today, thus reflecting considerable changes in land use patterns.

A. CHANGES IN FARMS AND FARMLAND USE

A farm consists of a place of 10 or more acres (4 ha) from which sales of farm products amounted to $50 or more in the preceding calendar year, or a place of less than 10 acres (4 ha) from which sales of farm products amounted to $250 or

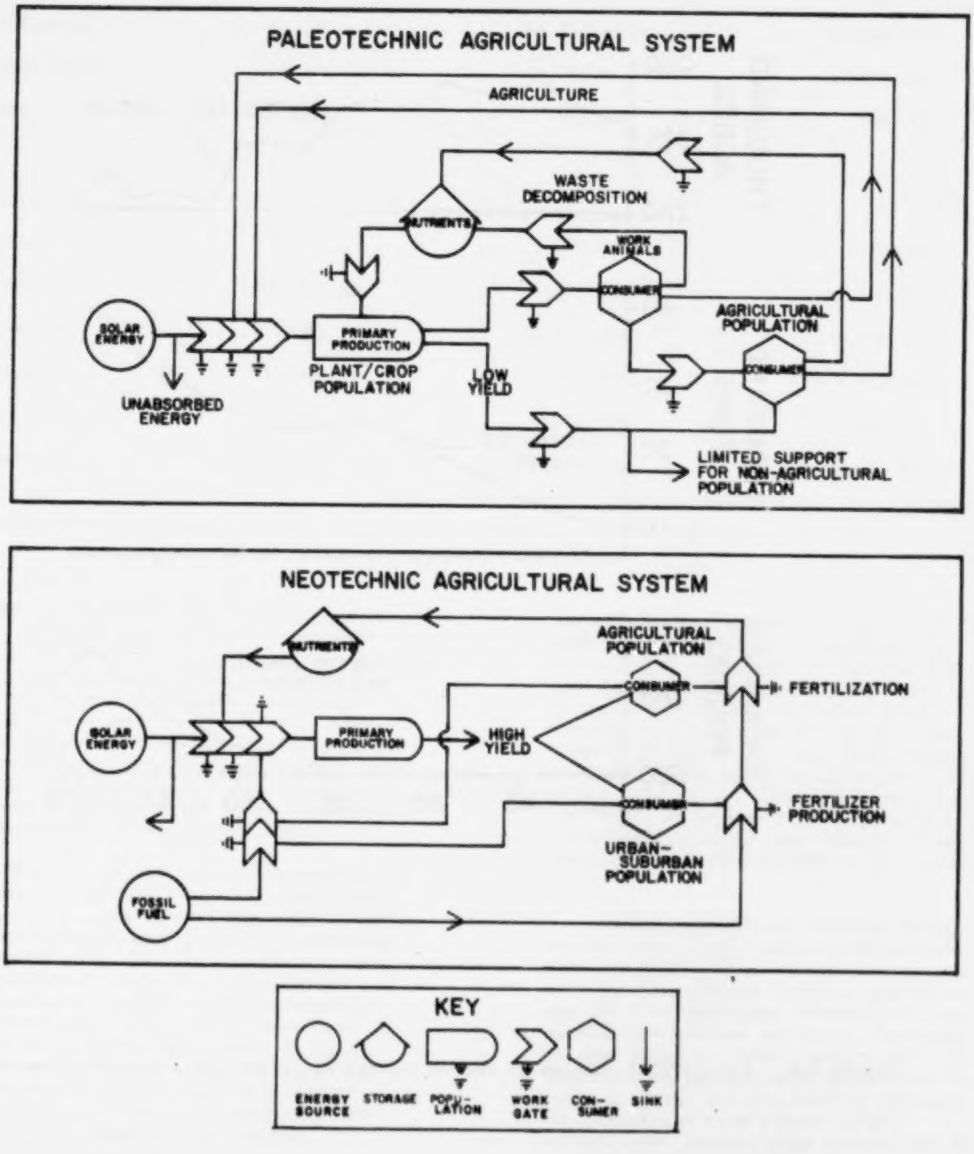

PALEOTECHNIC AGRICULTURAL SYSTEM
AGRICULTURE
WASTE DECOMPOSITION
NUTRIENTS
WORK ANIMALS
CONSUMER
SOLAR ENERGY
PRIMARY PRODUCTION
PLANT/CROP POPULATION
UNABSORBED ENERGY
LOW YIELD
AGRICULTURAL POPULATION
CONSUMER
LIMITED SUPPORT FOR NON-AGRICULTURAL POPULATION
NEOTECHNIC AGRICULTURAL SYSTEM
NUTRIENTS
AGRICULTURAL POPULATION
CONSUMER
FERTILIZATION
SOLAR ENERGY
PRIMARY PRODUCTION
HIGH YIELD
CONSUMER
FERTILIZER PRODUCTION
URBAN-SUBURBAN POPULATION
FOSSIL FUEL
KEY
ENERGY SOURCE
STORAGE
POPULATION
WORK GATE
CONSUMER
SINK

Figure 6-7. Comparative models of the paleotechnic agricultural system where animal and human labor predominate, and the neotechnic system where scientific farming is the regulating factor (adapted from Manners 1974).

more in the preceding year (South Carolina Budget and Control Board 1978).

Dramatic changes have occurred in South Carolina and Georgia farms and farmland use in the past 50 years. Most striking has been the decline in number of farms for all coastal counties of the study area (Tables 6-2 and 6-3). The county experiencing the greatest percentage decrease in total number of farms was Beaufort County with a 67.6% change. Chatham, Glynn, and McIntosh counties experienced about 57% decreases. This decline is probably continuing, indicating that farm operations have become heavily mechanized, and that changes in land use have occurred.

Another striking aspect of change has been the decline in acreage of farms. With such large reductions in farms and farm area, it is not surprising that cropland acreage likewise has declined. During the period 1964 - 1974, acreage of land in farms dropped sharply in most coastal counties. This was particularly true for McIntosh and Glynn counties where a change of 88.6% was experienced. For a discussion of the biological utilization of abandoned farmlands see Volume III, Chapter Six.

The average farm size for most coastal counties in South Carolina has increased, while in most coastal counties of Georgia the farm size has decreased during the period 1964 to 1974. In South Carolina, the coastal county which experienced the greatest percentage increase in farm size was Beaufort County with a 157.4% increase. In Georgia, McIntosh County showed the greatest decrease in farm size, from 578 acres (234 ha) to 153 acres (62 ha), during the same period.

B. CHANGES IN CROP ACREAGE BY CROP TYPE

Cropland harvest is defined as the land from which cultivated crops were harvested; land from which hay (including wild hay) was cut; and land in small fruits, vineyards, nurseries, and greenhouses (South Carolina Budget and Control Board 1978).

Table 6-4 provides crop acreages by crop type in the Sea Island Coastal Region of South Carolina for the years 1964 and 1974. In Berkeley County, corn and soybean crops continued to increase in the number of acres while the cotton acreage declined dramatically during this period. In Georgetown County, about 1,000 acres (405 ha) were added to the corn crop acreage, while the soybean crop added about 900 acres (364 ha) to the total cultivated land. Charleston, Colleton, and Dorchester counties experienced an increase in acres of wheat, corn, soybean, and sorghum crops and a decrease in acres of vegetables, sweet potatoes, and hay crops. The counties with significant declines in acres of wheat, hay, and vegetables were Beaufort and Jasper.

Major crop lands for the coastal counties of Georgia were located in Effingham, Chatham, and Bryan counties. Effingham and Chatham counties experienced a decline in corn lands and significant increases in acres of soybeans and vegetables (Table 6-5). In Bryan County, corn and soybeans were the two major crops for which there were large increases of crop lands.

Since World War II, many South Carolina and Georgia farmers have come to recognize the value of pastures in their farm operations. Educational and promotional programs from the U.S. Department of Agriculture and the agricultural colleges have encouraged grassland farming as a wise use of the land. Grasses and legumes have been used over the years for establishment of permanent improved pasture, in crop rotation systems, and generally for conserving and improving the soil. Much idle land and wasteland has been returned to production through grassland farming. The soils of South Carolina and Georgia, like most of the humid Southeast, have been leached of their original fertility and, in many cases, have been eroded. Large quantities of commercial fertilizers must be used to maintain crop yields. Many soils have lost organic matter which absorbs and stores plant nutrients and increases waterholding capacity. Grassland farming can restore much of this organic matter and has been effectively applied to help control erosion.

South Carolina farmers have established a considerable acreage of permanent pasture under cost sharing conservation programs. In addition to soil improvement, farmers have found that grassland farming can increase income by providing grazing, silage, and hay for dairy cattle, beef cattle, or other livestock. Some farmers have augmented their income by selling the hay or seed from their grazing or cover crops (Hart 1968). The income from livestock and livestock products has increased as South Carolina and Georgia farmers have used more of their land for pasture, particularly in support of dairy and beef cattle (Fairey 1978).

A survey of beef cattle farms in the South in 1968 showed that there was a trend for small beef cattle farms to divert more of their land to forage than the larger farms. Parts of South Carolina, Georgia, and Alabama characterize this change. It was noted also that many farmers, after losing their allotted acreage or having the quantity reduced, had to divert their land to non-allotted crops or uses. Forage crops have competed well with other non-allotted uses, particularly where the remaining allotted

Table 6-2. **Agricultural development in terms of growth in number of farms, acres of land in farm, and size of farm, in South Carolina, 1964 and 1974 (U.S. Department of Commerce, Bureau of the Census 1968a, 1977b).**

Item	COUNTIES							
	Beaufort	Berkeley	Charleston	Colleton	Dorchester	Georgetown	Horry	Jasper
Number of Farms								
1964	472	1,472	465	1,424	1,050	832	3,885	433
1974	153	788	251	748	541	384	2,156	255
Growth:1964 - 1974								
Number of Farms	-319	-684	-214	-678	-509	-448	-1,729	-178
Percent (%)	-67.6	-46.5	-46.0	-47.2	-48.5	-53.8	44.5	-41.1
Total Lands in Farm (acres)[a]								
1964	97,645	149,945	95,997	309,825	117,145	126,365	322,835	146,525
1974	81,500	79,748	75,342	256,581	83,598	59,578	222,836	106,192
Growth:1964 - 1974								
Lands in Farm (acres)	-16,145	-70,195	-20,655	-53,244	-33,547	-66,787	-99,999	-40.333
Percent (%)	-16.5	-46.8	-21.5	-17.2	-28.6	-52.9	-31.0	-27.5
Average Size of Farm (acres)								
1964	207	102	206	217	112	83	83	338
1974	533	101	300	343	154	155	103	416
Growth:1964 - 1974								
Size of Farm (acres)	326	-1	94	126	42	72	20	78
Percent (%)	157.4	-0.1	45.6	58.0	37.5	86.7	24.0	28.0

a. 1 acre = 0.4047 ha

Table 6-3. Agricultural development in terms of growth in number of farms, acres of land in farm, and size of farm, in Georgia, 1964 and 1974 (U.S. Department of Commerce, Bureau of the Census 1968b, 1977c).

	COUNTIES						
Item	Bryan	Camden	Chatham	Effingham	Glynn	Liberty	McIntosh
Number of Farms							
1964	151	58	228	472	126	86	72
1974	108	66	94	345	54	70	31
Growth:1964 - 1974							
Number of Farms	-43	8	-134	-127	-72	-16	-41
Percent (%)	-28.4	13.7	-58.7	-26.9	-57.1	-18.6	-56.9
Total Lands in Farm (acres)[a]							
1964	35,203	55,995	47,214	138,586	45,131	70,373	41,613
1974	30,769	38,508	21,536	98,012	12,185	27,123	4,732
Growth:1964 - 1974							
Land in Farm (acres)	4,434	-17,487	-25,678	-40,574	-32,946	-43,250	-36,881
Percent (%)	-12.5	-31.2	-54.3	-29.2	-73.0	-61.4	-88.6
Average Size of Farms (acres)							
1964	233	965	207	293	358	818	578
1974	285	583	229	284	226	387	153
Growth:1964 - 1974							
Size of Farm (acres)	52	-382	22	-9	-132	-431	-425
Percent (%)	22.3	-39.5	10.6	-3.0	-36.8	-52.6	-73.5

a. 1 acre = 0.4047 ha

Table 6-4. Crop acreage[a] by crop type in the Sea Island Coastal Region of South Carolina, 1964 and 1974 (U.S. Department of Commerce, Bureau of the Census 1968a, 1977b).

Crop Type	Beaufort		Berkeley		Charleston		Colleton		Dorchester		Georgetown		Horry		Jasper	
	1964	1974	1964	1974	1964	1974	1964	1974	1964	1974	1964	1974	1964	1974	1964	1974
Corn	3,816	4,885	11,166	13,285	2,666	3,924	19,352	21,112	13,524	11,964	5,074	6,005	30,696	30,123	7,077	9,105
Sorghum	0	100	160	104	177	616	389	110	222	116	17	188	44	234	0	46
Soybeans for Beans	5,236	7,182	5,540	8,807	10,159	11,832	16,238	28,418	10,898	15,154	1,717	2,623	20,634	35,925	3,275	8,796
Peanuts for Nuts	1	14	12	12	27	17	82	88	25	19	10	7	354	135	3	0
Wheat	725	530	218	957	1,017	2,544	195	913	63	327	39	84	366	787	55	15
Other Small Grains	289	202	642	343	137	43	2,951	905	1,476	734	204	48	1,869	1,089	452	253
Cotton	223	0	5,105	666	52	0	4,111	189	7,168	198	946	4	1,798	474	1,167	1
Tobacco	0	0	426	401	0	0	553	433	657	395	1,480	1,326	16,575	17,104	39	0
Irish & Sweet Potatoes	21	86	40	58	1,430	48	26	10	26	13	45	24	1,125	527	13	1
Hay Crops	1,885	933	3,873	1,262	1,954	1,107	3,760	2,954	1,480	1,475	1,326	894	1,826	1,069	3,632	1,241
Vegetables, Sweet Corn & Melons	7,428	3,997	483	861	11,200	5,062	1,203	493	447	163	102	23	348	302	1,754	675
Land in Orchards	263	229	49	16	493	76	169	58	28	27	27	7	162	93	38	12
Berries	1	0	1	0	1	6	2	0	0	2	1	0	61	36	0	0
Other Crops	(NA)[b]	5	(NA)	254	(NA)	190	(NA)	38	(NA)	64	(NA)	32	(NA)	197	(NA)	0

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[a] 1 acre = .4047 ha.

[b] (NA) - Data not available.

Table 6-5. Crop acreage[a] by crop type in the coastal counties of Georgia, 1964 and 1974 (U.S. Department of Commerce, Bureau of the Census 1968b, 1977c).

Crop Type	Bryan		Camden		Chatham		Effingham		Glynn		Liberty		McIntosh	
	1964	1974	1964	1974	1964	1974	1964	1974	1964	1974	1964	1974	1964	1974
Corn	1,952	3,038	27	169	1,305	1,073	13,549	11,484	149	109	997	1,285	377	72
Sorghum	-----[b]	57	50	---	109	-----	52	110	---	---	---	-----	---	40
Soybean for Beans	500	1,624	---	83	553	1,037	3,684	11,055	---	---	---	-----	---	--
Peanuts for Nuts	103	191	---	4	---	-----	518	322	---	---	---	2	---	--
Wheat	-----	45	---	---	---	25	161	346	---	---	---	-----	---	--
Other Small Grains	-----	95	---	---	---	300	---	617	---	15	---	-----	---	16
Cotton	81	-----	---	---	4	---	1,256	---	---	---	23	-----	3	--
Tobbacco	175	183	6	---	7	---	175	128	---	---	77	74	2	--
Irish & Sweet Potatoes	7	7	---	---	8	1	68	19	---	---	1	-----	---	--
Hay Crops	-----	287	---	302	---	334	6	1,294	---	411	---	193	---	230
Vegetables, Sweet Corn, and Melons	49	14	270	20	183	8	457	105	4	2	8	38	22	1
Land in Orchards	17	8	9	2	196	92	205	119	101	4	4	14	6	28
Berries	-----	-----	---	6	---	---	4	---	---	---	---	-----	---	2
Other Crops	(NA)[c]	4	(NA)	13	(NA)	108	(NA)	45	(NA)	8	(NA)	2	(NA)	--

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a. 1 acre = .4047 ha.
b. -- Insufficient Data.
c. (NA) - Data not available.

acreage on farms has been adapted to the most suitable soils. As many farmers have taken non-farm jobs, much of their land has been idled or shifted from crop land to grazing land because it requires less labor and less machinery (Strough 1971).

C. CHANGES IN VALUE OF FARM PRODUCTS SOLD

During 1964 - 1969, the value of farm products sold per farm within the characterization area was highest in Beaufort County, with an increase from $10,400 to $23,500 (Tables 6-6 and 6-7). The value of farm products sold per farm in Charleston and Chatham counties was slightly lower than in Beaufort County in 1964 and 1969. In terms of total value of farm products sold, five counties located in or near the large urban areas of Charleston and Berkeley counties decreased slightly during 1964 and 1969. Overall farm profit change can be understood by examining the total gross income and production expenses for South Carolina farmers (Table 6-8). Comparison of the statistics for 1949 - 1975 reveals an increase in expenses as a percent of gross income.

D. FOREST LAND

Forest land is defined as land at least 16.7% stocked by forest trees of any size, or formerly having had such tree cover and not currently developed for non-forest use.

Forest land, like pasture land, has increased considerably since World War II. Much of the rural land which has gone out of active farm status is largely forest land that is now owned by private individuals, such as retired farmers, doctors, lawyers, businessmen, housewives, or heirs. The 1970 census reports of the U.S. Department of Commerce did not give a meaningful record of total forest land. However, Forest Service reports provide statistics on forest acreage owned by farmers and other private owners for the 10-year intervals 1947, 1958, and 1968 (Knight and McClure 1969). The changes and distribution in these forest statistics reflect the changes that have occurred on farms and farmland.

The last two forest survey reports (1958 and 1968) reveal that much of the idle and abandoned farmland in the study area was allowed to revert to forest. Idle or abandoned lands, according to these reports, are the best sites for the regeneration or re-establishment of trees. In addition, the U.S. Department of Agriculture has encouraged the planting of trees on the steep, rough, eroded or abandoned lands where cultivation could not be continued or where permanent pasture could not be established.

Because of the large share of forest land that farmers and private non-farm owners hold, the future of the forest industry depends on how they will use the land. Since 1958, the area of commercial forest owned by farm operators in South Carolina decreased from 6.8 million to 5.0 million acres (2.8 million to 2.0 million ha), whereas areas of commercial forest in the miscellaneous private category increased from 2.4 million to almost 4.3 million acres (.97 million to 1.74 million ha). The shift is more evident in the Piedmont. Over this same period, forest industries increased their commercial forests from 1.7 million to 2.0 million acres (.69 million to .81 million ha), and the area of public-owned forest land has remained at about 1.1 million acres (.45 million ha) (Knight and McClure 1969).

From these findings, the fact remains that farmers and other individuals still own three-fourths of the commercial forest land in South Carolina. Their forestry attitudes and actions will determine, to a large degree, the future timber supply. Cognizant of this fact for some time, governmental and private organizations have directed their efforts toward the planting and improvement of private forest land. Educational and technical assistance to farmers and private land owners has been provided by State extension foresters, county agricultural agents, State service foresters, and various private forest industry foresters. Tree planting became a major means of forest replenishment only in the last two decades. The Agricultural Conservation Programs, which provide Federal cost sharing to land owners for planting trees, have been in effect since 1958. Some of the largest acreages in the study area were planted between 1959 and 1962 because tree planting was made most favorable during this (Soil Bank) period by payments to farmers who planted pines (U.S. Department of Agriculture 1974).

Recognizing the dollar value of forest products and minimal use of farm labor and machinery, many farmers have turned to tree farming on a large scale (Prunty 1963). Landowners have recognized tree planting as a viable, more extensive use of the land. The trend to tree planting has been aided by restricted cropland allotments, released sharecropped holdings, and land retirement programs, like the Soil Bank, as well as the reduced profitability of traditional cash cropping. The extensive woodland plantation also has been most accommodating to the increasing number of absentee landowners.

1. Forest Acreage and Production

As acreage of farmland has rapidly declined in recent decades, the use of land for commercial forestry has received a strong stimulus. In 1968, all coastal counties in South Carolina, except Beaufort, contained more than 260,000 acres (105,222 ha) of commercial forest land (Table 6-9).

Table 6-6. Agricultural development in terms of growth in total value of farm products sold, and value per farm, in South Carolina, 1964 and 1969 (U.S. Department of Commerce, Bureau of the Census 1967, 1972a, 1973b).

	COUNTIES							
Item	Beaufort	Berkeley	Charleston	Colleton	Dorchester	Georgetown	Horry	Jasper
Total Value of Farm Products Sold ($1,000)								
1964	4,908	3,021	5,697	4,937	4,529	3,032	26,918	1,624
1969	5,044	2,966	5,457	6,467	3,935	2,715	28,807	1,626
Growth:1964 - 1969								
Change in Value ($1,000)	136	-55	-240	1,530	-594	-317	1,889	2
Change in Percent (%)	2.0	-1.8	-4.2	30.9	-13.1	-10.4	7.0	0.12
Value of Farm Products Sold per Farm ($1,000)								
1964	10.4	2.05	12.25	3.46	4.31	3.64	6.92	3.75
1969	23.50	4.68	23.22	6.24	4.70	5.14	9.52	6.60
Growth:1964 - 1969								
Change in Value per Farm ($1,000)	13.10	2.63	10.97	2.78	0.39	1.50	2.60	2.85
Change in Percent (%)	125.9	128.2	89.6	80.3	9.04	41.2	37.5	76.0

Table 6-7. Agricultural development in terms of growth in total value of farm products sold, and value per farm, in Georgia, 1964 and 1969 (U.S. Department of Commerce, Bureau of the Census 1968b, 1972b).

	COUNTIES						
Item	Bryan	Camden	Chatham	Effingham	Glynn	Liberty	McIntosh
Total Value of Farm Products Sold ($1,000)							
1964	520	361	1,741	2,224	591	486	166
1969	591	776	1,823	2,973	108	514	197
Growth:1964 - 1969							
Change in Value ($1,000)	71	415	82	749	-483	28	31
Change in Percent (1%)	13.6	114.9	4.7	33.6	-81.7	5.7	18.6
Value of Farm Products Sold per Farm ($1,000)							
1964	3.44	6.22	7.63	4.71	4.69	5.66	2.30
1969	4.72	16.86	20.26	7.34	3.59	4.71	6.16
Growth:1964 - 1969							
Change in Value per Farm ($1,000)	1.28	10.64	12.63	2.63	-1.10	0.95	3.68
Change in Percent (%)	37.2	171.00	165.50	55.80	-23.40	-16.70	167.80

Table 6-8. South Carolina farm income and production expenses, 1949 - 1975 (in millions of dollars) (Fairey 1978).

Year	Gross Income	Production Expenses	Net Income	Expenses as % of Gross Income
1949	401.5	197.8	203.7	49.3
1950	398.3	198.7	199.6	49.9
1951	529.6	234.7	294.9	44.3
1952	480.7	242.6	238.1	50.5
1953	478.0	237.9	240.1	49.8
1954	405.1	234.7	170.4	57.9
1955	440.5	239.0	201.5	54.2
1956	443.0	248.5	194.5	56.1
1957	414.4	251.2	163.2	60.6
1958	434.8	255.7	179.1	58.8
1959	417.5	269.1	148.4	64.4
1960	418.8	266.0	152.8	63.5
1961	447.7	281.0	166.7	62.8
1962	464.6	279.3	185.3	60.1
1963	462.6	284.4	178.2	61.5
1964	465.4	290.1	175.3	62.3
1965	472.3	299.9	172.5	63.5
1966	495.4	304.3	191.1	61.4
1967	516.3	324.3	192.0	62.8
1968	481.4	325.0	156.4	67.5
1969	525.1	350.7	174.4	66.8
1970	554.8	404.5	150.4	72.9
1971	562.3	429.0	133.3	76.3
1972	653.6	460.4	193.2	70.4
1973	815.5	554.2	261.2	68.0
1974	956.6	687.8	268.8	71.9
1975	929.2	730.7	198.5	78.6

Table 6-10 summarizes the acres of commercial forest land in the coastal counties of Georgia in 1971. The most important commercial forest counties are: Berkeley, Horry, Colleton, Georgetown, and Camden in that order. Almost all of the commercial forest lands are owned by private individuals and corporations.

To show the relative importance of forest type, acreage of commercial forest land by type of forest is listed in Tables 6-11 and 6-12. As can be seen in the tables, three important groups in the study area are: 1) loblolly-shortleaf pine, 2) oak-pine, and 3) oak-gum-cypress. Tables 6-13 and 6-14 summarize the forest production and growing stock data. Growing stock is defined as all trees 5 in (12.7 cm) in diameter and larger of desirable species and quality.

2. Timber Trends

a. South Carolina. This section is based on information acquired in the 1968 forest survey of South Carolina by the U.S. Forest Service and published in South Carolina's Timber, 1968 (Knight and McClure 1969).

The area of forest land in South Carolina has been on the increase ever since the first forest survey, in 1936; today, commercial forests occupy 12.4 million acres (5.02 million ha) or 64% of the total land area. Since 1958, about 910,000 acres (368,272 ha) of commercial forest were added, while 435,000 acres (176,042 ha) were diverted to other land uses (Table 6-15). During this period, almost two-thirds of the net gain occurred in the Piedmont, where the reversion of former agricultural lands to forest is most evident. Most of the remaining gain occurred in the southern coastal plain, where a large share of the tree planting effort has been concentrated.

Although this upward trend in forest area is encouraging to forestry interests and may continue for a short while, increased competition from alternate land uses should not be underestimated over the long run. Food and fiber needs will determine to a large degree the shifts between forest and agricultural use; however, the permanent diversion of forest land from future timber production is a matter of some concern. For example, since 1958, about 185,000 acres

Table 6-9. Area of commercial forest land, by ownership type, in the coastal counties of South Carolina, 1968 (thousands of acres[a]) (Cost 1968, Welch 1968).

	COUNTIES							
Ownership Type	Beaufort	Berkeley	Charleston	Colleton	Dorchester	Georgetown	Horry	Jasper
National Forest	- -	154.5	68.3	- -	- -	- -	- -	- -
Miscellaneous - Federal	3.1	8.6	1.4		- -	- -	3.4	- -
State	2.0	14.3	1.0	0.7	1.4	0.1	0.6	- -
County and Municipal	0.8	0.6	2.0	1.7	1.2	0.3	0.1	- -
Forest Industry	22.5	165.5	73.7	89.7	83.0	235.2	129.9	63.5
Farmer	64.2	71.9	49.8	279.0	133.6	54.4	313.0	97.0
Miscellaneous - Private								
Corporate	- -	11.0	- -	3.0	13.7	2.0	- -	- -
Individual	61.3	152.1	105.8	110.4	30.0	96.8	39.1	152.4
All Ownerships	153.9	578.5	302.0	484.5	262.9	388.8	486.1	312.9

a. 1 acre = .4047 ha.

Table 6-10. Area of commercial forest land, by ownership type, in the coastal counties of Georgia, 1971 (thousands of acres[a]) (Bellamy 1971).

	COUNTIES						
Ownership Type	Bryan	Camden	Chatham	Effingham	Glynn	Liberty	McIntosh
National Forest	- -	- -	- -	- -	- -	- -	- -
Miscellaneous - Federal	95.1	4.5	1.6	- -	1.4	105.3	0.7
State	b	- -	b	- -	1.5	- -	12.9
County and Municipal	- -	- -	1.2	0.2	b	- -	- -
Forest Industry	54.6	128.6	36.0	55.4	84.9	56.2	119.3
Farmer	30.0	9.2	19.2	58.5	3.8	9.6	11.3
Miscellaneous - Private							
Corporate	3.0	18.3	- -	8.3	11.5	- -	17.0
Individual	45.0	160.0	65.3	125.4	72.4	81.5	39.7
All Ownerships	227.7	320.6	123.3	247.8	175.5	252.6	200.9

a. 1 acre = .4047 ha.
b. Less than 50 acres.

Table 6-11. Area of commercial forest land by forest-type group and county, South Carolina, 1968 (thousands of acres[a]) (Cost 1968, Welch 1968).

Forest Type	COUNTIES							
	Beaufort	Berkeley	Charleston	Colleton	Dorchester	Georgetown	Horry	Jasper
Longleaf-slash pine	15.4	62.3	21.5	72.7	32.7	29.6	20.6	70.2
Loblolly-shortleaf pine	27.0	221.9	121.8	109.4	52.8	133.7	159.8	46.1
Oak-pine	29.2	83.1	71.4	58.6	53.2	62.6	92.8	71.0
Oak-hickory	42.7	81.2	35.0	66.2	13.7	49.8	107.8	43.2
Oak-gum-cypress	39.6	120.7	52.3	169.5	107.8	113.1	102.7	50.1
Elm-ash-cottonwood	- -	9.3	- -	8.1	2.7	- -	2.4	32.3
Total All Type Groups	153.9	578.5	302.0	484.5	262.9	388.8	486.1	312.9

a. 1 acre = .4047 ha.

Table 6-12. Area of commercial forest land by forest-type group and county, Georgia, 1971 (thousands of acres[a]) (Bellamy 1971).

	COUNTIES						
Forest Type	Bryan	Camden	Chatham	Effingham	Glynn	Liberty	McIntosh
Longleaf-slash pine	91.9	146.5	14.6	84.4	53.5	110.7	74.5
Loblolly-shortleaf pine	40.8	33.2	25.6	26.7	23.3	38.3	18.2
Oak-pine	34.8	44.0	18.5	50.6	37.6	25.0	16.1
Oak-hickory	13.5	28.7	38.2	35.2	41.4	37.0	27.3
Oak-gum-cypress	46.7	65.2	26.4	43.8	19.7	41.6	53.5
Elm-ash-cottonwood	- -	3.0	- -	7.1	- -	- -	11.3
Total All Type Group	227.7	320.6	123.3	247.8	175.5	252.6	200.9

a. 1 acre = .4047 ha.

Table 6-13. Forest production, by product type, on commercial forest land in South Carolina coastal counties, 1968 (Cost 1968, Welch 1968).

	COUNTIES							
Product Type	Beaufort	Berkeley	Charleston	Colleton	Dorchester	Georgetown	Horry	Jasper
Saw timber in million board feet (includes all species)	544.1	2,326.7	1,100.5	1,644.9	1,054.9	1,616.1	1,694.3	978.0
Growing stock in million cubic feet (includes all species)	167.6	717.0	362.7	577.9	343.5	533.8	569.0	340.4

Table 6-14. Forest production, by product type, on commerical forest land in Georgia coastal counties, 1971 (Bellamy 1971).

	COUNTIES						
Product Type	Bryan	Camden	Chatham	Effingham	Glynn	Liberty	McIntosh
Saw timber in million board feet (includes all species)	58.7	60.8	30.3	54.4	45.2	58.5	36.5
Growing stock in million cubic feet (includes all species)	15.3	17.0	7.7	15.2	10.6	15.9	11.6

Table 6-15. Changes in area (in thousands of acres) of commercial forest land, by survey unit, South Carolina, 1958 - 1968[a] (Knight and McClure 1969).

Survey Unit	Area of commercial forest land in:		Net change	Changes							
					Additions from:			Diversions to:			
	1968	1958		Total gain	Non-forest	Noncommercial forest	Total loss	Noncommercial forest	Agriculture	Urban and Other	Water
Southern Coastal Plain	3,269.4	3,112.9	+156.5	260.7	260.7	- -	104.2	1.6	57.0	37.8	7.8
Northern Coastal Plain	4,687.4	4,676.2	+ 11.2	206.3	206.3	- -	195.1	12.3	109.9	70.3	2.6
Piedmont	4,453.9	4,145.8	+308.1	443.4	431.5	11.9	135.3	- -	68.6	45.8	20.9
State Total	12,410.7	11,934.9	+475.8	910.4	898.5	11.9	434.6	13.9	235.5	153.9	31.3

a. The 1978 forest survey report by U.S. Department of Agriculture is currently being prepared; data for this report were not available.

(74,868 ha) of commercial forest land have been lost to reservoirs, highways, and urban development. As the population increases, more and more of this permanent diversion of forest land is inevitable. The point is, in the not-too-distant future, timber requirements will have to be met with a decreasing forest acreage.

Previous forest surveys in South Carolina have indicated a downward trend in the area of commercial forest occupied with pine and oak-pine types, with hardwood types on the increase. The new findings show a reversal of these trends, with pine and oak-pine stands up 14% and hardwood stands down 9% since 1958. These changes in forest type are attributed to a number of factors. First, forestry efforts in South Carolina have been oriented toward growing more pine timber, and the results of these efforts are now appearing in the statistics. Except for fire protection, an equal effort has not been put forth to grow more hardwood. The conversion of scrub oak and other low-quality hardwood stands to pine has become common practice. Another contributing factor has been that pines have seeded naturally, thereby stocking many acres of idle or abandoned agricultural land. In fact, pines dominate the hardwoods on over 80% of all new forest land added since 1958, regardless of origin. Finally, the diversion of commercial forest land to other uses has taken a heavier toll on the hardwood stands.

Loblolly pine is the leading forest cover type in South Carolina and occupies over 2.9 million acres (1.2 million ha). Oak-hickory, with 2.3 million acres (0.9 million ha), is the second leading type. Close behind is the oak-pine type, which occupies over 2.1 million acres (0.8 million ha). In this type, southern pine makes up at least 25% but less than 50%, of the live-tree stock.

Since 1958, the area of commercial forest occupied by sapling and seedling stands increased from 2.7 million to 3.6 million acres (1.1 million - 1.5 million ha), or 33%. This increase is attributed to the extensive tree planting programs in South Carolina, as well as to the natural reversion of old fields back to forest. Forest surveys show that, statewide, about 850,000 acres (343,990 ha) of forest land originated wholly, or in part, from artificial regeneration since 1958. Of course, some of the plantings were unsuccessful, and some sapling and seedling stands grew to poletimber or were diverted to other land uses. Altogether, the figures are reasonably consistent for concluding that about one-fourth of the sapling and seedling stands in South Carolina are well-stocked pine plantations established within the past 10 years. With adequate protection and good management, these young stands will make a substantial contribution to the future timber supply.

Between 1947 and 1958, the volume of growing stock declined about 5%, causing concern among forestry interests in South Carolina. Perhaps, then, the most significant finding of the new survey is that this downward trend in volume has been reversed (Fig. 6-8). Gains were made in each of the three survey units (Southern Coastal Plain, Northern Coastal Plain, and Piedmont) and across all diameter classes. The recovery is attributed to the success of intensified efforts aimed at increasing the timber supply and to a general decline in annual removals up until about 1961.

Between 1958 and 1968, the volume of growing stock increased from 10.3 billion to about 12.2 billion ft^3 (0.29 billion - 0.35 billion m^3), or 19%. Increases in the volume of loblolly and slash pine accounted for almost one-half of the net gain, even though these species make up only 29% of the inventory. As a group, the red oaks accounted for another 20% of the net gain, although they make up only 12% of the inventory. The fact that the most desirable red oaks make up only a small part of this volume removes some of the luster from the increase. Less desirable species, such as laurel, water, and willow oaks, are the primary red oaks in South Carolina in terms of volume.

One disturbing aspect of the volume trends is that volume of water tupelo, black gum, sweet gum, and soft-textured hardwoods in general has increased relatively little. These species are vital to some of the hardwood industries, particularly the veneer industry.

The analysis of volume trends has been based on cubic volume changes in sawtimber and, since 1958, follow a similar pattern. Currently, almost half of the sawtimber in South Carolina is found in the northern coastal plain (Fig. 6-9). There, average volume per acre exceeds 3,500 board feet, well above the average in the other two survey units.

b. Georgia. Data in this section are statewide and based primarily, except where otherwise noted, on Georgia's Timber, 1972 (Knight and McClure 1974), published by the U.S. Forest Service.

Georgia, with 24.8 million acres (10.0 million ha) of commercial forest, has more timberland than any other State except Oregon. Georgia is also a major agricultural State and since the early thirties the forest survey has monitored changes in land use back and forth between forest and agriculture. For at least three decades, the natural reforesting of idle and abandoned agricultural lands, along with extensive tree planting on open areas, more than offset all

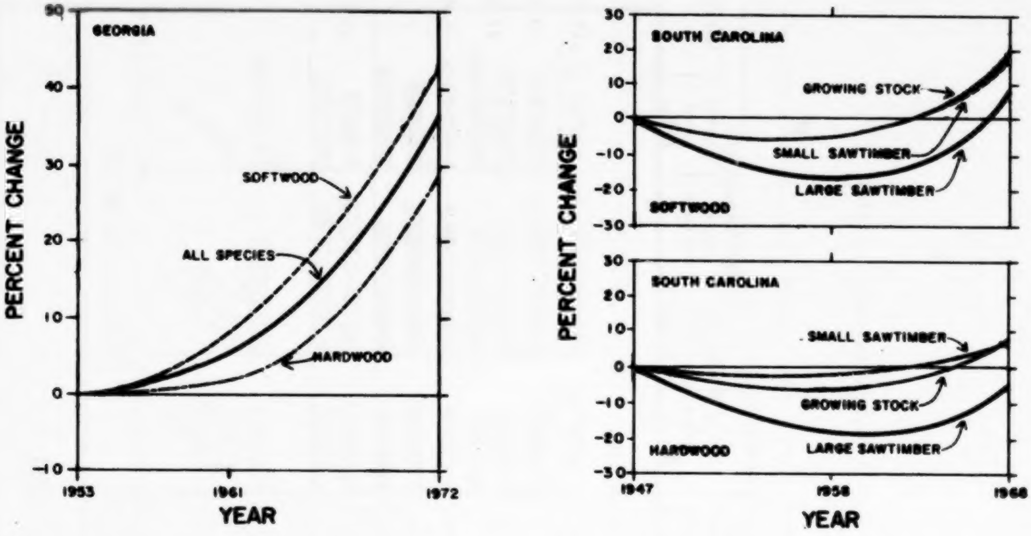


Figure 6-8. Percent change in timber volume in South Carolina and Georgia (Knight and McClure 1969, 1974).

diversions of forest to other land uses. These changes eventually added some 4.5 million to 5.0 million acres (1.8 million to 2.0 million ha) to the area classified as commercial timberland.

As additions of new forest land diminished and the rate of forest diversion accelerated, the forest base began to recede across the entire State. Between 1961 and 1972, the net loss of commercial forest land totaled almost 1 million acres (404,694 ha), or 3.7%.

This net decrease of slightly less than 1 million acres in Georgia's timber base over an 11-year period masks land use changes on more than 3 million acres (1.2 million ha) of land. About 2 million acres (809,389 ha) of commercial forest were diverted to nontimber uses, and more than 1 million acres (404,694 ha) of forest were added. A further description and breakdown of these changes by survey unit adds resolution to the overall land use picture (Table 6-16).

Tree planting on open lands accounted for about 43% of the forest additions. Most of the remaining additions resulted from the natural reversion of idle lands, and therefore did not represent any planned or direct forestry investment on the part of the owners or land managers. Because idle agricultural land is the primary source of prospective forest additions, a downward trend in idle land suggests that there will be less opportunity in the future for adding forest acres. For example, the area of idle agricultural land in Georgia has decreased from 2.1 million to 0.7 million acres (849,858 to 283,286 ha) within the past 20 years.

The withdrawal of more than 325,000 acres (131,525 ha) in the wetlands portion of the Okefenokee National Wildlife Refuge in Southeast Georgia from commercial forest explains a significant part of the overall reduction in the timber base. Commercial timber harvesting is no longer permitted on these lands; therefore, they were reclassified to productive-reserved forest in the 1972 forest survey. Similar withdrawals of this magnitude are not anticipated.

Altogether, the clearing and diversion of commercial forest to agricultural use removed some 956,000 acres (386,887 ha) from the forest base (Table 6-16). More than half of the diversion to agricultural use was to pasture, a common land use change observed throughout the State. About 420,000 acres (169,971 ha) of the diversion was to cropland, largely concentrated in the coastal plain. Relatively little cropland was added in the piedmont and mountains. Additional diversions of forest land to agricultural uses are probable.

Although most of the large water impoundments which exist in Georgia were created prior to 1961, construction of new lakes and ponds flooded an estimated 83,000 acres (33,589 ha) previously classified as forest (Table 6-16).

In summary, most of the land use trends point to a further reduction in

Table 6-16. Changes in area[a] of commercial forest land, by survey unit, for Georgia, 1961 - 1972 (Knight and McClure 1974).

Survey Unit	Area of commercial forest land in: 1961	Area of commercial forest land in: 1972	Net change	Changes: Total gain	Changes: Additions from: Non-forest	Changes: Additions from: Noncommercial forest	Changes: Total loss	Changes: Diversions to: Noncommercial forest	Changes: Diversions to: Agriculture	Changes: Diversions to: Urban and Other	Changes: Diversions to: Water
Southeast	7,945.0	7,440.6	-504.4	201.5	201.5	- -	705.9	335.8	221.3	129.7	19.1
Southwest	3,064.5	2,884.8	-179.7	186.4	186.4	- -	366.1	12.8	294.4	45.8	13.1
Central	7,416.6	7,321.9	-94.7	250.0	249.0	1.0	344.7	3.9	203.1	110.4	27.3
North Central	4,084.6	3,999.2	-85.4	287.9	287.9	- -	373.3	1.9	140.8	215.8	14.8
North	3,277.4	3,192.5	-84.9	130.7	128.2	2.5	215.6	1.7	97.0	107.8	9.1
State	25,788.1	24,839.0	-949.1	1,056.5	1,053.0	3.5	2,005.6	356.1	956.6	609.5	83.4

a. Thousands of acres.

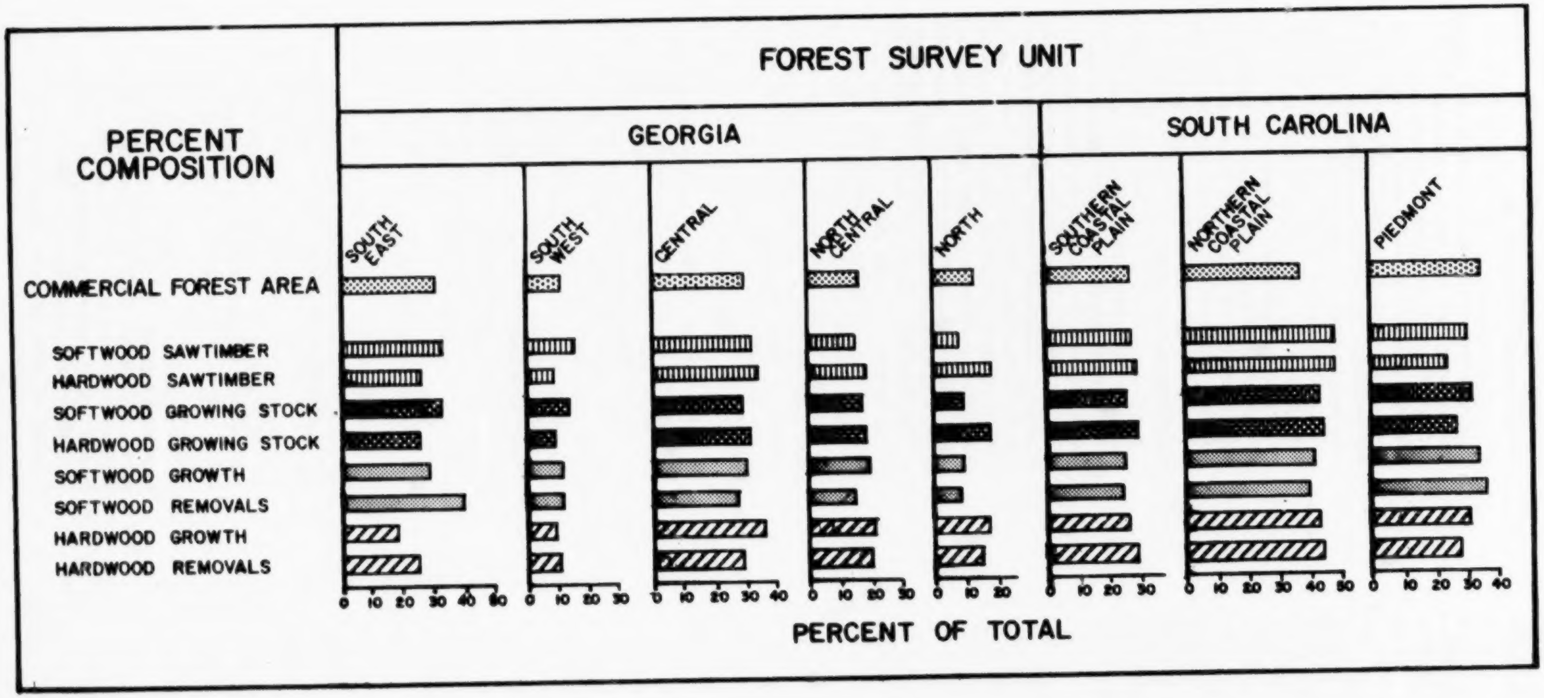


Figure 6-9. Relative importance of forest resources, by survey unit, for South Carolina (1968) and Georgia (1972) (Knight and McClure 1969, 1974).

commercial forest land in Georgia. Similar trends prevail throughout much of the Nation.

The area of commercial forest land classified as farmer-owned has declined from about 15.0 million to 8.4 million acres (6.1 million to 3.4 million ha), or by 44%. Although a large share of the forest diversion occurred in this owner ship class, most of the decline is attributed to land transactions and changes in owner occupations. Undoubtedly, some inconsistency between surveys in the classification of forest owners is also involved, but not to the extent that would greatly distort the measure of real change. The fact remains that the greatest change in the forest ownership pattern in Georgia between 1961 and 1972 occurred in a real shift from farmer to miscellaneous private.

Most of the loss in farmer-owned forest land does show up as a gain in the miscellaneous private owner class where the area of commercial forest soared from 4.9 million to 10.5 million acres (2.0 million to 4.2 million ha). Miscellaneous private owners now control more of Georgia's timberland than any other class of owner.

Other changes in forest ownership include a 9% gain in forest industries lands, which increased from 3.9 million to 4.3 million acres (1.6 million to 1.7 million ha). In addition to these fee-simple holdings, forest industries have almost a million acres (0.4 million ha) of commercial forest under long-term lease.

Except for the withdrawal of the wetlands portion of the Okefenokee National Wildlife Refuge, there has been little change within the public ownership pattern. Only about 1.6 million acres (0.6 million ha), or 6%, of the commercial forest land is publicly owned.

The inventory of growing-stock timber on commercial forest land increased from 19.6 billion to 25.3 billion ft^3 (5.5 million to 7.2 million m^3), or by 29%, between 1961 and 1972. This means that the rate of increase in timber volume accelerated in spite of the reduction in forest area (Fig. 6-8). This sizable buildup in timber inventory is largely attributed to the high proportion of young stands which grew from sapling to poletimber size during the period. In 1972, sapling and seedling stands occupied 25% of the commercial forest, as compared to 45% in 1961.

This buildup in timber inventory has not been uniformly distributed across the State. Almost 80% of the volume increase since 1961 has occurred in the Piedmont and mountains. By forest survey unit, the increase ranged from a low of 9% in southeast Georgia to a high of 58% in north central Georgia.

Two species, loblolly pine and slash pine, accounted for more than half of the total net gain in volume. Generally, forest managers have favored loblolly and slash pine over all other species in timber cultural activities. This has been especially true in artificial reforestation. Substantial increases in volume were also found in most of the oaks, sweet gum, and poplar. Smaller increases in volume occurred in such major species as short leaf pine, black gum, hickory, and red maple. Volume in longleaf pine, cypress, and ash declined slightly.

The only extensive area in coastal Georgia that experienced a reduction in timber volume was a group of counties south of the Altamaha River in southeast Georgia. Unusually heavy timber harvesting in this area, stand conversion, and similar forest activity, in spite of extensive tree planting, have created a rather delicate timber supply situation in which removals are exceeding growth. One of the heaviest concentrations of wood-using industry in the South is found in and around this area. Almost 40% of the softwood timber removals from Georgia's commercial forests came out of the southeast unit in 1971. Stumpage prices are higher in this area than in any other part of the State, reflecting the higher demand.

The survey findings suggest that forest industries obtaining timber from this area will need to search out other sources of supply while awaiting young stands to reach marketable size. Some 1.6 million acres (0.6 million ha), or about half of all the plantations in the State, have been established in southeast Georgia. Seventy percent of these planted stands, however, are less than 15 years old (U.S. Department of Agriculture, Forest Service 1968).

3. Timber Products Output

In terms of volume, pulpwood is the leading timber product in the coastal plain region. In fact, Georgia leads the Nation in pulpwood production. Since the 1950's, pulpwood production has increased in the study area in response to increasing demands and available raw materials, land, climate, and trees (Pikl 1960).

Utilization of timber by-products is highly efficient since it does not involve additional cuts of standing timber. With the current rate of expansion in the lumber and plywood industries, it is conceivable that the pulpmills will be obtaining an even greater share of their wood requirements from by-products. In recent years, a substantial number of chip-n-saw mills have been established.

The pulp industry, dependent primarily upon wood fiber, is able to utilize most species and a wide range of tree sizes and quality classes. Nevertheless, the industry's current procurement system reflects a strong preference for softwood and is often in competition with the lumber industry for the sawtimber-quality trees (Fig. 6-10). There are 10 pulpmills located within the vicinity of the characterization area (Fig. 6-11). In addition, numerous other wood-using industries occur in the Sea Island Coastal Region.

Since 1961, pulpwood production has increased by almost 50% in both Georgia and South Carolina (Fig. 6-10). Recently, however, some soft spots have developed in the pulp markets, and the rate at which new capacity is being added has slowed markedly. The pulp industry has expended large sums of money on modernization and on air and water pollution abatement, which undoubtedly has affected the allocation of available capital. As long as population and economic activity continue to grow, however, the demand for pulp and paper products will likely be strong. Ultimate scarcities and rising prices of raw materials such as petroleum, together with environmental factors relating to manufacturing, pollution, and problems of disposal of nonbiodegradable by-products, will tend tc limit inroads of competitive materials into pulp markets.

It would be extremely difficult to predict with any reliability the future wood requirements for the lumber industry in Georgia and South Carolina; however, several important factors which could influence this industry should be noted. Over the next few decades, the Nation is faced with the major task of building new houses for some 100 million people, plus major repair and replacement of older housing. Urban rehabilitation appears likely to require tremendous volumes of building materials. Demands for furniture, other manufactured products, and shipping and handling materials continue to increase. The production of wooden pallets has just about doubled within the past 10 years, and the annual production of railroad cross-ties has turned upward in recent years after a long decline. The conclusion is that lumber production in South Carolina and Georgia will very likely continue its recent upward trend (Knight and McClure 1969, 1974).

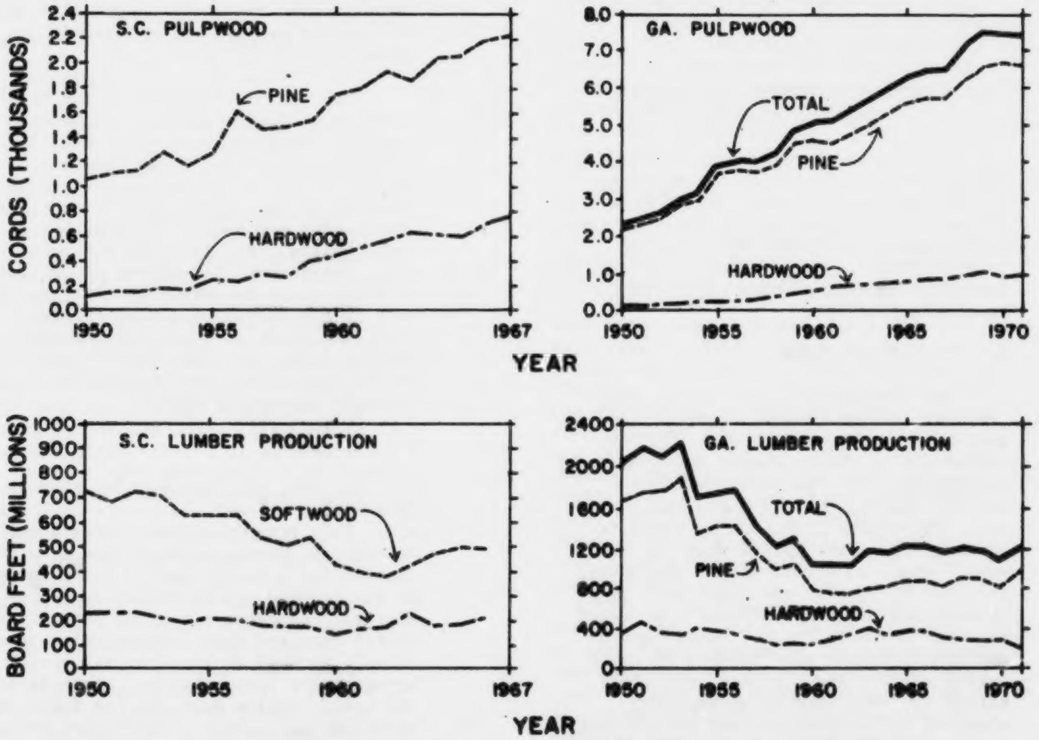


Figure 6-10. Pulpwood and lumber production in South Carolina (1950 - 1967) and Georgia (1950 - 1971) (Knight and McClure 1969, 1974).

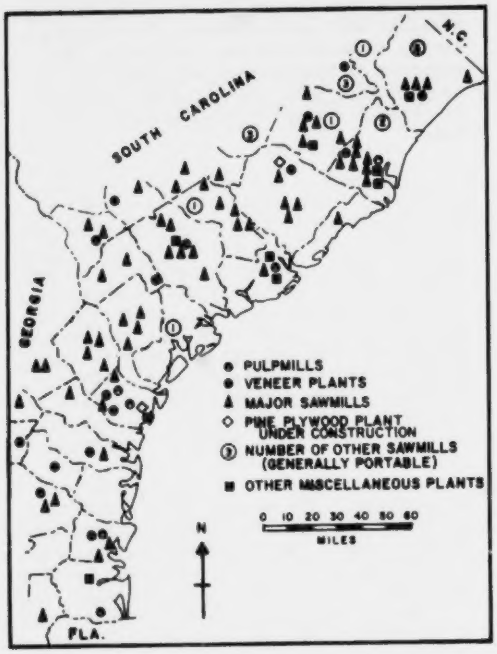

SOUTH CAROLINA
N.C.
GEORGIA
FLA.
● PULPMILLS
● VENEER PLANTS
▲ MAJOR SAWMILLS
◇ PINE PLYWOOD PLANT UNDER CONSTRUCTION
③ NUMBER OF OTHER SAWMILLS (GENERALLY PORTABLE)
■ OTHER MISCELLANEOUS PLANTS
0 10 20 30 40 50 60
MILES
N

Figure 6-11. Location of primary wood-using industries in the Sea Island Coastal Region (Knight and McClure 1969, 1974).

III. FACTORS AFFECTING AGRICULTURAL LAND USE CHANGE

The discussion that follows shows the salient factors of change operative in the Sea Island Coastal Region from a review of literature and statistical data of the South, Southeast and Atlantic Coastal Plain regions. Much of the information in this section was extracted from Fairey (1978).

A. DECLINE OF COTTON

The decline of cotton was an integral part of the general decline of cropland acreage in the Southeast. Cotton production in the Southeast has diminished continually over the past few decades and now remains only in a few small pockets. The Cotton Belt economy began declining during the 1920's when the boll weevil began to spread across the South. The loss of some of the negro work force to northern industrial cities also began as early as World War I. These factors and others caused many farmers to cease cotton cultivation. Others, who could afford it, continued by mechanizing planting and cultivation and by applying insecticides against pests. After World War II, high production levels and fluctuating domestic and foreign demand reduced the market price of cotton. This was the impetus for legislation to limit production and uphold prices. Acreage allotment restrictions were imposed on cotton in 1950 and then continued from 1954 to 1975 (Hart 1976).

The allotment programs, which artificially maintained the price of cotton through price supports, actually encouraged the consumption of other less expensive fibers. The higher price of cotton relative to synthetic fibers encouraged textile manufacturers to use less all-cotton fiber and more synthetic or cotton-synthetic blends (Clemson University 1974). With the declining consumption of cotton, allotments also declined. Despite this fact, many small farmers continued to plant cotton under the price support system, without which such farming might not have been economically feasible. Indeed, purist economists argue that allotment/price support programs have stymied needed change in the Southeast (Blakeley 1965).

Cotton production historically was tied to allotted acreage under the agricultural commodity programs. After 1965, however, the program allowed transfers of allotted acreage within the State. In South Carolina, this permitted cotton allotments no longer used in the Piedmont to be transferred to the coastal plain, mainly the inner coastal plain, where farmers could assemble economically viable cotton growing units (Clemson University 1967).

The decline of cotton in the coastal counties of South Carolina and Georgia began in the first quarter of the 1900's. Presently in the Sea Island Coastal Region, little or no cotton acreage is recorded in any of the coastal counties (Tables 6-4 and 6-5). For a number of these coastal counties, the milder climatic conditions allowed the production of truck crops to partially fill the gap left by the demise of cotton (Salter 1968). A study of fruit and vegetable markets shows that this pattern was well established before the mid-1940's (Clemson University 1946).

B. SOIL BANK

In 1956, the Conservation Reserve Program was established by the Soil Bank Act. This program allowed farmers under contract to divert acreage from crop production for 3 to 10 years. The purpose of the program was to reduce crop surpluses. Contractors were to maintain diverted cropland under conservation practices. Farmers received annual rental payments for land taken out of production and could receive cost-sharing funds for establishing various conservation practices, such as tree planting, water impoundments, or wildlife habitat improvements (U.S. Department of Agriculture

1974). The program allowed the retirement of approximately one quarter of the allotted acreage in the South. Land was diverted from crop production in both the Piedmont and inner coastal plain, particularly in Georgia and South Carolina (Blakeley 1965). The program reached its peak in 1960 and tapered off until the completion of the 10-year contracts in 1970.

Substantial diversion of cropland under the program occurred throughout the Sea Island Coastal Region. Diversion occurred both in the Piedmont, where cropland acreage declined most, and in the inner coastal plain, where cropland declined least over the study period. Presumably, a large share of the diverted acreage was former cotton land. The lack of participation in the program by many counties of the Pee Dee area of the coastal plain is related to the predominance of tobacco cultivation there. Although ultimate disposition of the diverted acreage is difficult to determine, apparently a large share was converted to forest land. Program records show, for example, that in South Carolina between 1956 and 1964, over 357,000 acres (144,476 ha) of land in the Soil Bank were planted with trees under the cost share agreements (Clemson University 1969). This amounts to about 56% of the maximum acreage (1960) ever under contract. A study in the piedmont of Georgia indicated that about 40% of the land had been converted to pines (Georgia Agricultural Experiment Station 1966).

C. LAND QUALITY

Land quality has a significant influence on the use of farm land. On the aggregate, land quality has affected the geographical distribution of cropland use or non-use. As mechanization increased after World War II, it became more efficient to use large, level, and well-drained fields. The advent of crop acreage allotments and the development of a more competitive economic situation encouraged farmers to crop their most productive land. Hart (1968) documented the decline of farmland in the Southeast, noting that Georgia and South Carolina suffered particular loss. Although he investigated the effects of several factors, he concluded that quality of land was the single most significant factor.

The quality of land has become a more influential factor as farmers increasingly have become aware of soil characteristics and land capabilities through soil surveys or other technical information provided by agricultural agencies and institutions. The coastal plain, with broad level lands, lent itself to mechanization and larger field sizes. Drainage projects, supported through government programs, made usable many acres of formerly poorly drained soils in the coastal plain. In addition, the sandy soils responded well to increased application of commercial fertilizers.

Land quality varies from place to place and is largely dependent upon soil characteristics. The quality of a soil for agricultural use is related to its physical and chemical characteristics, such as slope, depth, structure, pH, and degree of wetness or erosiveness. Not only does soil affect agricultural land use, but it also is affected by it. The U.S. Soil Conservation Service developed a measure of land quality which includes the existing and potential conditions of land for agricultural use. This measure is called the land capability classification and its soils are grouped into major classes which identify degree of risk in using the soil (U.S. Department of Agriculture, Soil Conservation Service 1970). For a description of the soils found in the Sea Island Coastal Region, consult Volume I, Chapter Three.

Geographically, pasture and forest land and other land uses change concomitantly with cropland. Land in the coastal plain shifted to pasture and forest, but to a lesser extent than in the Piedmont. In the coastal plain, where more of the land is suitable for cultivation, farmers continued a greater dependence on crop agriculture. In the Sea Island Coastal Region, cropland declined least on better quality land and most on poorer quality land. At present, cropland is concentrated on the better quality land while pasture and forest occupy intermediate and poor quality land (U.S. Department of Agriculture, Soil Conservation Service 1970).

D. URBANIZATION

Opinions about the effects of urban expansion on farmland, including urban sprawl and road construction, vary widely. Some studies in local areas reveal that urban expansion has had a significant effect. Such a study in Madison County, Tennessee, for example, showed that the development of transport routes had the effect of fracturing land parcels to the extent that large scale farming was impossible (Fairey 1978). Good agricultural land is often encroached upon because it is the land which offers the least resistance to development, both physically and economically. Since the best farmland is usually cleared, level land and in a rural setting, it is attractive to real estate developers and prospective dwellers. It is attractive to developers because it is cheaper than existing land in the city and requires less clearing or leveling than most undeveloped land. Its attraction to prospective dwellers is in the amenities of country living, real or imagined. The processes of sprawl have been documented by studies in the heavily populated Northeast. Frequently, the decline of farmland is not clustered around cities, but is dispersed in the urban fringe (Delaware Agriculture Experiment Station 1962). Much of the land around cities becomes subdivided for real or suspected urban uses. In many cases, this land is idled from farming and reverts to brush or trees. Farmers in the fringe complain that increasing taxes, declining sources of labor, and competition for land have caused them to cut back or quit farming altogether (Kollke 1966).

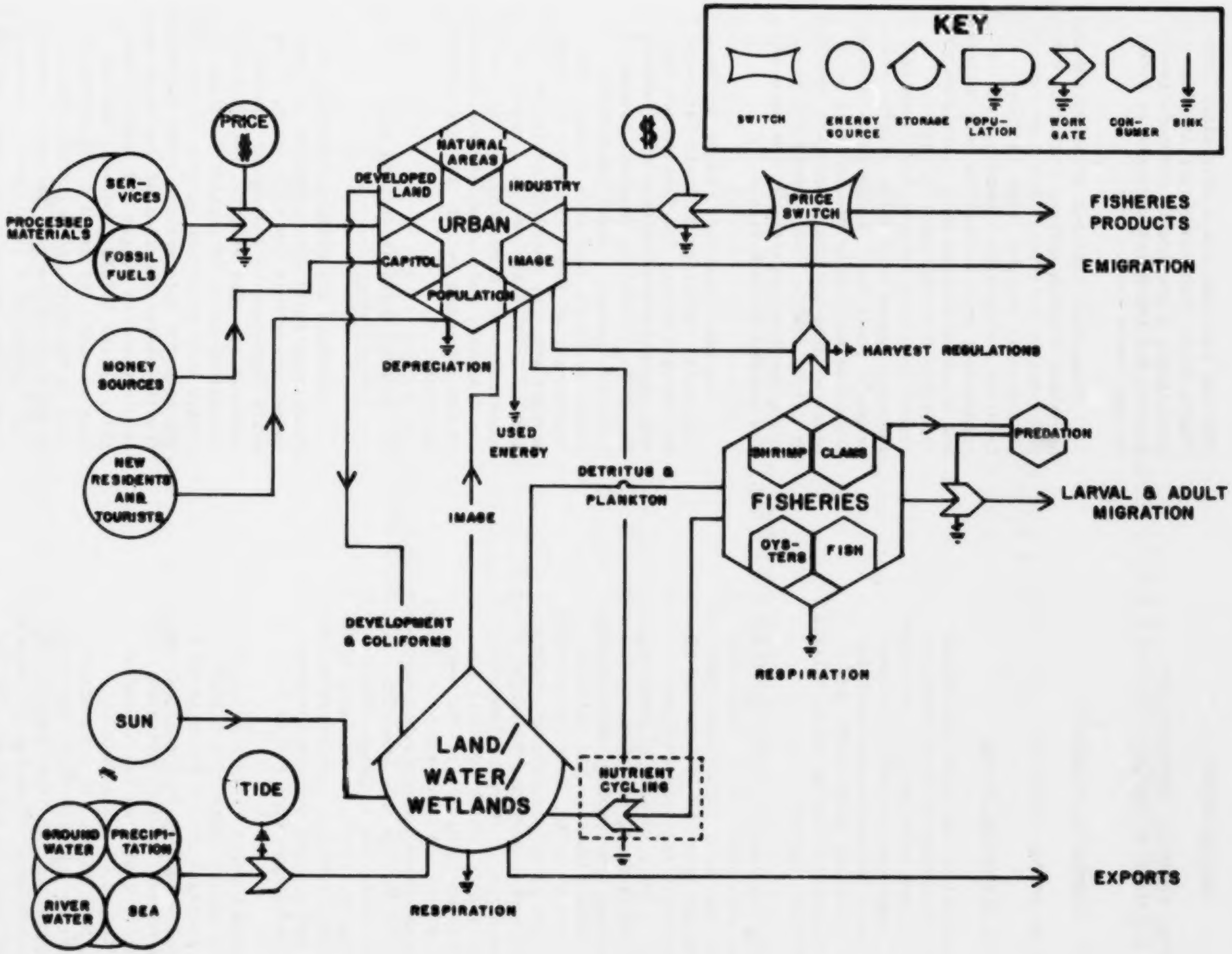
The seriousness of the consequences of urban expansion on agricultural land is variously debated and depends largely upon the scale from which it is viewed. Nationally, it can be expected that a little over 4% of the Nation's land will be urbanized by the year 2000. Most of this will be near major metropolitan areas. Severe competition will arise in localized areas where productive agricultural land, because of terrain or soil characteristics, is in short supply. Because urban expansion tends to bring a permanent and visibly different land use; usually occurs along routes of travel; diminishes some of the perceived amenities of rural farmland; brings people, pests, and pollution; and disrupts country life styles and values; it is often assigned a greater significance than its area alone merits (Hart 1976).

Although almost half of the Sea Island Coastal Region's population is classified as urban by the U.S. Bureau of the Census, area-wise, it is still a rural area. In 1967, approximately 5% of the total area of South Carolina was in urban or built-up areas (Fairey 1978). Major urban development has occurred near the existing large towns and cities. In the coastal plain, urban population has increased most in Charleston, Horry, Beaufort, Berkeley, Glynn, and Liberty counties (Table 3-3).

Comparing the change of urban population with the decline of cropland shows no consistent relationship. Area-wise, the effects of urban development have been localized and attributed to a small percent of the total area. Obvious examples of sprawl occur near larger cities and on idle land resulting from fractionalization of former farmland by highway construction.

The secondary effects of urban growth, such as loss of labor to industries and businesses, the increasing cost of land, and impaired travel between farm tracts are very real problems to full-time farmers. Although no one has examined the effects of urbanization on South Carolina and Georgia natural resources, it is probable that the effects have been more economic and social than a physical displacement of resources.

Figure 6-12 shows the major inputs (urban and natural), components (urban, plankton and fisheries systems), and pathways connecting components and external markets in the coastal plain. This model has been simplified to illustrate the effects of urbanization on the South Carolina and Georgia coastal systems.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DEVELOPMENT & COLIFORMS
SUN
TIDE
LAND/ WATER/ WETLANDS
NUTRIENT CYCLING
GROUND WATER
PRECIPI-TATION
RIVER WATER
SEA
RESPIRATION
EXPORTS

Figure 6-12. Simplified urbanization model for the Sea Island Coastal Region of South Carolina and Georgia. Model shows inputs (urban and natural), components (urban, plankton, and fisheries), and pathways connecting components and external markets.

CHAPTER SEVEN

COASTAL FISHERIES CONSERVATION AND UTILIZATION

I. COMMERCIAL FISHERIES

A. OVERVIEW OF THE FISHERIES

1. General Historical Trends

Historically, the most significant commercial fisheries of South Carolina and Georgia have been based on estuarine dependent resources, primarily penaeid shrimp, blue crab, molluscan shellfish (eastern oyster and hard clam), and coastal finfish (including spot, mullet, and anadromous species).

During the latter part of the nineteenth and early part of the twentieth centuries, the major commercial fisheries in both States were for oysters and finfish (especially American shad and sturgeons). For a variety of reasons, including man-induced environmental perturbations, overfishing, and economic factors, these fisheries had declined significantly by 1920. With the development of otter trawling, penaeid shrimp became the most important commercial fishery resource in terms of landings during the 1920's, which is still the case at present (Table 7-1). Between 1918 and 1938 in Georgia, and from 1951 to 1957 in South Carolina, Atlantic menhaden were an important component of commercial fisheries landings (Table 7-1). During the 1950's, a valuable fishery for blue crabs was developed in South Carolina and Georgia and has continued through the present time (Table 7-1).

In recent years (1970 - 1976), South Carolina's annual commercial fishery landings averaged 20.5 million lb (9.3 million kg) valued at $9.4 million, and Georgia's annual landings averaged 15.9 million lb (7.2 million kg) valued at $8.4 million (U.S. Department of Commerce, NOAA 1976). In both States, penaeid shrimp (chiefly white and brown shrimp) and blue crab have remained the predominant coastal fisheries in terms of both total landings and value. In the case of the shrimp and blue crab fisheries, increasing demand and value continue to attract new investment and fishing effort even though these resources are apparently being exploited at or near their levels of maximum yield.

Oysters and hard clams continue to support important commercial fisheries in South Carolina, but to a much lesser extent in Georgia. Following the decline in landings in both States mentioned previously, oyster production in South Carolina increased somewhat in the 1950's and 1960's, declined significantly in 1968 and has remained stable since then (Table 7-1). The commercial landings of hard clams, a previously underutilized resource, has increased recently in both States (Table 7-1).

Commercial landings of estuarine and nearshore finfish species currently comprise only a relatively small proportion of the total seafood catch in South Carolina and Georgia. Landings of the predominant species such as spot, mullet, and blueback herring have fluctuated considerably over the past 20 years, primarily due to natural environmental factors, degree of fishing effort, and economic condition. Landings of heavily exploited anadromous species such as American shad and sturgeons have remained at fairly stable levels since the significant declines reported at the turn of the century in both States.

The most important change in the commercial fisheries of South Carolina and Georgia during the past decade has been the increased harvest of offshore resources, including demersal fishes (snapper, grouper, etc.), swordfish, calico scallops, and rock shrimp. The development of these fisheries has been brought about by diversification on the part of local fishermen as a result of competition and economics, as well as by the discovery and subsequent exploitation of the resources by out-of-State fishery interests.

2. General Characterization of the Seafood Industry

Although the seafood industry is relatively small when compared to other industries within the study area, it is still important to individual coastal communities. For example, the ex-vessel (dockside) value of fishery landings averages only about one quarter of the cash receipts for agricultural crops raised in the 14 coastal counties of the study area (South Carolina Budget and Control Board 1978, Akioka 1978). However, one has only to visit the small fishing communities in Beaufort and McIntosh counties to appreciate the real values of commercial fishing on a local level. McIntosh County alone accounts for nearly one-half the total pounds and dollars recorded annually for Georgia fisheries (U.S. Department of Commerce, NOAA 1976). Fishery landings in Beaufort County represent 33% - 51% of the total South Carolina catch. On a community basis, the individual capital investments in the seafood industry are rather significant. McKenzie et al. (1976) showed a total capital investment of over $10 million in the Beaufort County commercial fisheries. Laurent et al. (1975) found that the average dockside shrimp dealer in South Carolina had an investment of $55,000. Similar investments would be expected in

Table 7-1. Historical catch statistics (in thousands of pounds) for major commercial fishery species in South Carolina and Georgia, 1880 - 1978 (Lyles 1967; U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

	SOUTH CAROLINA						GEORGIA					
Year	Shrimp	Crabs	Oysters^a	Clams^a	Menhaden	Shad	Shrimp	Crabs	Oysters^a	Clams^a	Menhaden	Shad
1880	630	42	238	48	(1)	208	56	7	393	24	(1)	252
1887	338	76	180			366	185	45	619			255
1888	359	69	192			433	191	44	678			263
1889	380	86	208			577	150	43	917	3		356
1890	372	93	301			563	162	48	1,261	4		400
1897	374	110	1,023	185		506	68	75	2,735	3		788
1902	370	96	3,283	225		434	344	80	6,879	10		1,029
1908	452	33	7,440	76		464	528	196	8,070	43		1,333
1918	55	18	1,893	1		167	5,793	8	891	(1)	29,485	101
1923	355	9	3,422	86		184	10,688	120	1,381		26,973	134
1927	1,657	10	3,699	47		182	12,280	59	608	1	34,102	187
1928	431	2	3,942	26		320	9,526	569	842	1	30,030	317
1929	288	60	3,134	20		260	12,378	225	442	2	29,213	472
1930	793	26	3,249	11		214	8,853	228	159	2	24,701	275
1931	2,635	20	2,540			152	5,471	209	308	1	869	132
1932	1,501	16	2,418	5		123	3,602	225	588	1	11,520	288
1934	1,801	8	2,862	47		209	6,843	484	569		18,752	232
1936	1,101	1,636	3,118	20		177	9,715	2,182	330		14,500	236
1937	1,201	1,235	2,812	8		138	9,504	2,258	239		9,864	193
1938	3,723	848	1,761			59	10,426	1,854	154		7,034	98
1939	4,090	2,501	1,719	(1)		42	10,802	2,202	234		2,957	75
1940	1,784	4,145	2,203	3		50	9,336	2,348	265		234	150
1945	4,696	2,364	722	1		89	16,392	3,566	255			222
1950	7,746	2,872	1,374	7	961	73	11,157	5,028	308			180
1951	3,730	2,551	1,930	18	4,477	96	7,608	6,526	293			206
1952	4,072	2,605	2,249	8	3,218	136	5,991	9,459	221			243
1953	5,086	3,767	2,247	12	1,696	110	7,535	9,486	222			214
1954	6,644	2,489	2,562	9	3,952	196	7,742	10,640	217			180
1955	6,918	4,644	1,337	2	6,638	88	7,161	10,745	173			158
1956	5,589	1,902	2,186	2		116	7,991	8,542	120			168
1957	6,690	3,584	1,845	13	7,027	80	8,788	8,968	112			247
1958	5,815	4,839	1,437	120	861	71	8,746	10,185	143	2		319
1959	7,515	4,772	1,918	111	3,991	80	7,602	12,682	248			391
1960	8,030	7,121	2,627	97		106	10,403	15,766	232			533
1961	3,907	4,672	2,544	109		110	6,810	12,312	159			404
1962	6,474	6,338	2,674	59		115	8,610	12,303	147			527
1963	2,201	8,839	3,827	73		120	5,448	14,500	236			331
1964	2,632	9,436	2,511	146		120	5,939	11,532	196			314
1965	6,795	7,420	2,805	67	10	176	8,585	10,259	247			376
1966	4,264	5,724	2,615	23	235	119	6,470	8,556	181	0		386
1967	4,090	5,247	2,256	16	0	132	6,670	8,496	203	0		334
1968	6,336	3,862	2,120	10	253	110	8,620	3,669	191	0		569

Table 7.1. Concluded

	SOUTH CAROLINA						GEORGIA					
Year	**Shrimp**	**Crabs**	**Oysters**[a]	**Clams**[a]	**Menhaden**	**Shad**	**Shrimp**	**Crabs**	**Oysters**[a]	**Clams**[a]	**Menhaden**	**Shad**
1969	5,816	8,250	964	89	245	176	8,520	5,147	254	1		618
1970	4,952	6,950	852	87	10	148	6,030	7,092	179	17		532
1971	10,753	7,508	1,101	18	12	99	8,930	8,436	139	0		420
1972	8,084	7,422	1,120	48	2	159	7,280	9,059	152	0		344
1973	8,255	7,952	878	95	0	26	8,330	7,984	106	6		239
1974	7,466	7,548	1,119	123	2	24	7,260	10,131	65	0		162
1975	8,812	6,565	1,036	115	340	62	8,090	8,865	44	0		182
1976	8,864	5,740	1,187	172	0	32	7,772	5,873	72	11		93
1977	4,269	7,765	1,281	177	1	80	4,595	7,722	87	0		118
1978	5,115	9,426	1,353	185	1	288	5,667	10,760	20	0		172

a. Thousands of pounds of shucked meats.

Georgia since the fishing industries in both States share many of the same problems.

From a purely quantitative standpoint, the harvesting sector of the seafood industry presently has little impact on the region's economy as a whole. Seafood industry employment, one method of measuring relative economic importance, in the coastal counties of both South Carolina and Georgia combined contributes only about 3% of the aggregate county employment (Table 7-2). However, data are not available to analyze the entire seafood industry from harvesting and handling to storage, processing, distribution, and other sectors. Therefore, the true impact of the seafood industry on certain small coastal communities isolated from other job markets or characterized by populations possessing fishing skills should not be minimized.

The seasonality of fishing activities has a direct bearing on landings, and some of the major organizational problems facing the seafood industry today stem from this seasonality.

Shrimp, which support the most important of the region's fisheries, are caught only from May to December, with the peak quantities landed in July-August through October. Oysters are harvested from September to April. Crabs and finfish are harvested year around, but the catch is seasonal to some degree. Thus, it is difficult to obtain several different species of seafood at any one time of the year. This hinders the economic feasibility and efficiency of developing certain market organizations in the region. It is also difficult to sustain an on-going market organization with high quality labor utilizing single species facilities.

Figure 7-1 illustrates the seasonality problem in the Sea Island Coastal Region. At first glance, it appears that at least three species are being landed in commercial quantities in every month of the year, and that at least two species of finfish are landed each month. Figure 7-1 suggests that, with proper economic integration, a marine fisheries industry in the region could sustain a viable organizational structure year around. Over one-half of the value of the region's catch is landed in the second half of the year, however, with the peak months being June through October (Fig. 7-2). This coincides with the peak shrimp season and gives an indication of the importance of this particular fishery to the region. Thus, a major problem exists in sustaining cash flow in the 5 months beginning in December and lasting through April. These 5 months are the period in which oysters, crabs, clams, and black sea bass are in season. Consequently, prospects for more efficient organization of the industry depend heavily upon ability to catch and market some combination of oysters, crabs, clams, and black sea bass during the winter and early spring.

Hite and Stepp (1969) suggested that the potential for seafood processing in the coastal plains region was constrained by the absolute level and seasonality of the supply of catch. They also noted that the competitive position of the region for processing crabs, finfish, and oysters

Table 7-2. Estimated 1970 seafood industry employment in selected coastal counties of South Carolina and Georgia, based upon published and unpublished data by the National Marine Fisheries Service (South Carolina Budget and Control Board 1973, Akioka 1976).

STATE	TOTAL EMPLOYMENT IN SELECTED COUNTIES	SEAFOOD INDUSTRY EMPLOYMENT[a]	PERCENTAGE
Georgia[b]	94,031	3,063	3.3%
South Carolina[c]	52,550	1,590	3.0%
TOTAL	146,581	4,653	3.2%

a. "Seafood Industry Employment" includes an estimate of those involved in processing and wholesaling activities in these coastal counties.

b. Georgia: Camden, Chatham, Glynn, Liberty, and McIntosh counties only.

c. South Carolina: Charleston, Colleton, and Beaufort counties only.

SPECIES	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
OYSTERS	▒	▒	▒	▒	▥						▒	▒
SHRIMP	▥			▥	▒	▒	▒	▒	▒	▒	▒	▥
BLUE CRABS	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒
CLAMS	▒	▒	▒	▥							▥	▒
BLACK SEA BASS	▒	▒	▒	▒	▥	▥	▥	▥	▥	▥	▥	▥
SPOT					▥	▥	▒	▒	▒	▒	▒	▥
KING MACKEREL							▥	▥	▥	▥		
STRIPED MULLET								▒	▒	▒		
CATFISHES	▥	▥	▒	▒	▒	▒	▒	▥	▥	▥	▥	▥

▒ SIZABLE LANDINGS (>100,000 lb)

▥ NOMINAL LANDINGS (<100,000 lb)

Figure 7-1. Seasonality of principal species in catch, by species, South Carolina and Georgia commercial fisheries, 1972 (Laurent et al. 1975).

appears to be more favorable than for that of shrimp. Currently, shrimp processing operations in the region are concentrated in Georgia. The proximity of south Georgia to the year-round shrimping grounds off the Atlantic coast and Gulf of Mexico gives Georgia locational advantages as processors. Processing capacity in South Carolina is comparatively smaller. During 1975, processed fishery products in Georgia had a reported wholesale value of $48 million while South Carolina had only $8 million (Bell and Fitzgibbon 1978). In the same year, Georgia's raw breaded shrimp products ($30 million) constituted 23% of the total value of processed fishery products in the whole South Atlantic region.

The marketing channels in South Carolina and Georgia for seafood catches are geared to low volume, seasonal operations. Fishermen generally sell their catches to a relatively small number of coastal wholesalers (Table 7-3). In return for the fishermen's business, the dealers supply ice, fuel, bait, and docking space to the fishermen. Many of these wholesalers are also involved in limited processing of seafood products (i.e., deheading of shrimp, gutting finfish, etc.). Processors may also purchase catches directly from fishermen. In Georgia, most processors of shrimp and crab species buy heavily from local fishermen. Glynn County is the shrimp processing center in Georgia and McIntosh County is the center of oyster and crab processing in Georgia. South Carolina has only three processing plants (mainly crabs), located in Charleston and Beaufort counties.

There are also middlemen (brokers, merchant wholesalers, etc.) and a few major retail outlets drawing directly on the fisheries. Except for the processing sector, the seafood marketing system has evolved through tradition and, consequently wholesalers do not generally depend upon freezer storage (Laurent et al. 1975). A more detailed discussion of fisheries economics will be presented in treatment of the various segments of the seafood industry.

B. SEGMENTS OF THE FISHING INDUSTRY

1. The Shrimp Fishery

a. Description Of The Resource. Shrimp represent the principal fishery resource of South Carolina and Georgia. The shrimp industry of these States is based almost entirely on three shallow-water species of the family Penaeidae, the white shrimp, the brown shrimp, and the pink shrimp. Of minor importance to the shrimp fishery at present are rock shrimp and royal red shrimp. Atlas plate 45 presents a comparison of total landings by fishing area within each State.

Relative proportions of the two predominant species in catches from 1970 - 1977 are shown in Figure 7-3. White shrimp account for the bulk of the landings in the area with maximum catches in late summer, autumn, and early winter. In both States, small landings of white shrimp in spring are augmented by a much larger catch in autumn. The spring white shrimp fishery in this area is based on adults which have overwintered, while the

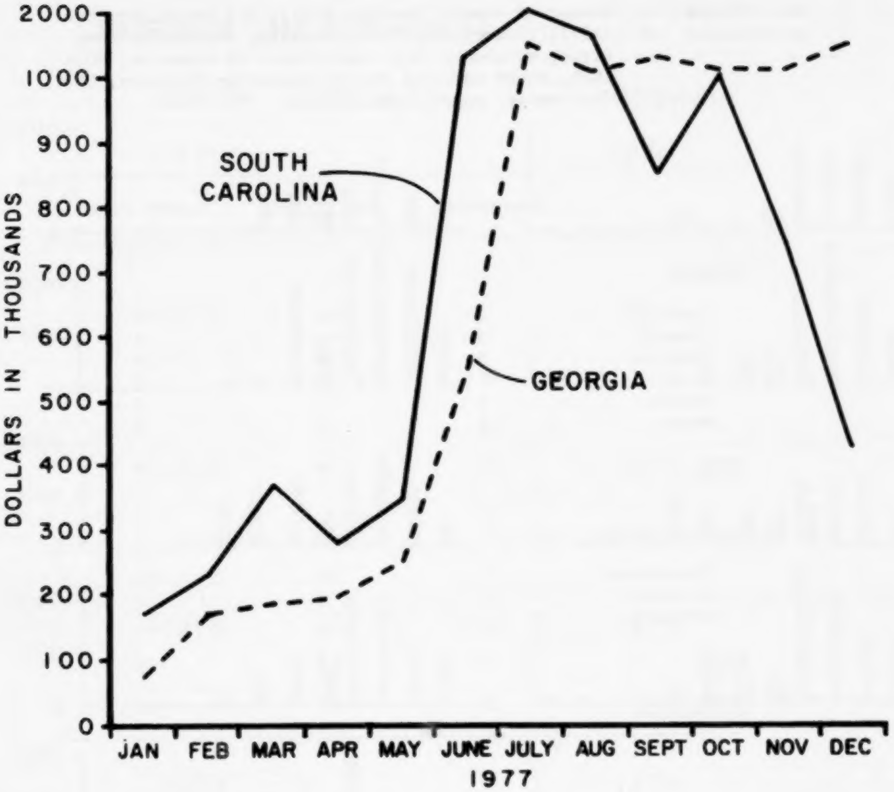

Figure 7-2. Dollar value of South Carolina and Georgia marine fisheries landings by month, 1977 (South Carolina Marine Resources Division, 1978, Charleston, unpubl. data; Georgia Department of Natural Resources, Coastal Resources Division, 1978, Brunswick, unpubl. data).

autumn catch is based almost entirely on young-of-the-year. During some years, catches of brown shrimp may exceed those of white shrimp for South Carolina. The peak of brown shrimp harvest occurs during summer in both States. The various shrimp species undergo considerable fluctuations in abundance from year to year as reflected by catch statistics (see Landing Trends). However, landings of white shrimp normally exceed those for brown shrimp when data are pooled for the region. Together, these two species typically account for about 95% of the total shrimp landings in the Southeastern United States. Pink shrimp are of major commercial significance along the Atlantic coast only in North Carolina, where it accounts for about one quarter of the total shrimp landings. This species is of only minor significance in South Carolina and Georgia.

White, pink, and brown shrimp utilize estuaries as nursery grounds for postlarval and juvenile stages. All species are exploited in bays, sounds, and nearshore waters. Although adult white shrimp are almost always vulnerable to capture, adult pink and brown shrimp migrate to offshore waters where they are "lost" to the fishery. These migrations occur before spawning, and spawning grounds within this region for both species are poorly known. In contrast, white shrimp normally spawn slightly offshore in depths from 6 to 24 m (20 to 80 ft).

Pink, brown, and white shrimp grow rapidly and most are caught before attaining 1 year of age. Because it is not possible to age shrimp precisely, their maximum age remains unknown. However, some individuals apparently can live for 18 to 24 months (Calder et al. 1974).

The major concentration of pink shrimp along this coast is located in North Carolina, and for management purposes they can be treated as one population or stock. It is not known definitely

Table 7-3. Number of coastal Georgia (1973) and South Carolina (1977) fishery products processing and wholesaling firms, by county (U.S. Department of Commerce, NOAA 1978, South Carolina Marine Resources Division, 1978, Charleston, unpubl. data).

	PROCESSORS	WHOLESALERS	COUNTY TOTAL
Georgia			
Chatham	2	11	13
Liberty	0	1	1
McIntosh	5	14	19
Glynn	7	6	13
Camden	0	5	5
Wayne	0	1	1
TOTAL	14	38	52
South Carolina			
Charleston	1	23	24
Colleton	0	5	5
Beaufort	2	15	17
TOTAL	3	43	46
GRAND TOTAL	17	81	98

whether there are one or several stocks of brown shrimp along the South Atlantic coast; however, catch statistics suggest that there may be only one (Calder et al. 1974). Although the definition of white shrimp stocks is poorly understood, catch statistics suggest that there may be several stocklets in this region (Calder et al. 1974). Stock definition of white shrimp is particularly difficult because larger shrimp generally migrate to the south whereas many whites overwinter in estuaries in North Carolina, South Carolina, Georgia, and the more saline waters of the east coast of Florida.

Abundances of the various species of shrimp vary greatly from year to year. However, the combined commercial catch of shrimp has not varied appreciably in the past 20 years, although 3 to 5 year trends in abundance of white shrimp have occurred during this period. This suggests that fishing has not adversely affected the abundance of shrimp during this time. In fact, the greatest threat to shrimp currently appears to be the alterations of the coastal environment by man.

Important information gaps concerning the shrimp resource are: 1) lack of knowledge concerning "loss" rates such as natural mortality, fishing mortality, and emigration; 2) the inability to adequately define growth rates; 3) the lack of adequate knowledge concerning spawner-recruitment relationships; and 4) insufficient data concerning the effects of intermediate to long-term environmental variations on shrimp populations.

All four factors impede development of harvesting strategies because of inadequate estimates of growth and "loss" rates. The first and third factors may also reduce yields by causing managers to become too conservative in establishing policies regarding the opening of the spring season for white shrimp. Lack of knowledge concerning effects of environmental variation upon shrimp abundance could cause severe economic perturbations if those variations led to significant declines in catches.

A critical lack of data exists regarding the impact on shrimp of man-made changes in estuarine habitats. Estuaries are being subjected to an ever-increasing array of stresses, ranging from increased levels of domestic and industrial pollution to direct loss of marsh areas due to channelization projects. Chapman (1968) observed that 200,000 acres (80,940 ha) of shallow coastal bays have been dredged and filled in the South Atlantic and Gulf States during the previous 20 years. Trent et al. (1972) noted that demand for waterfront housing, which frequently involves dredging, filling, and bulkheading,

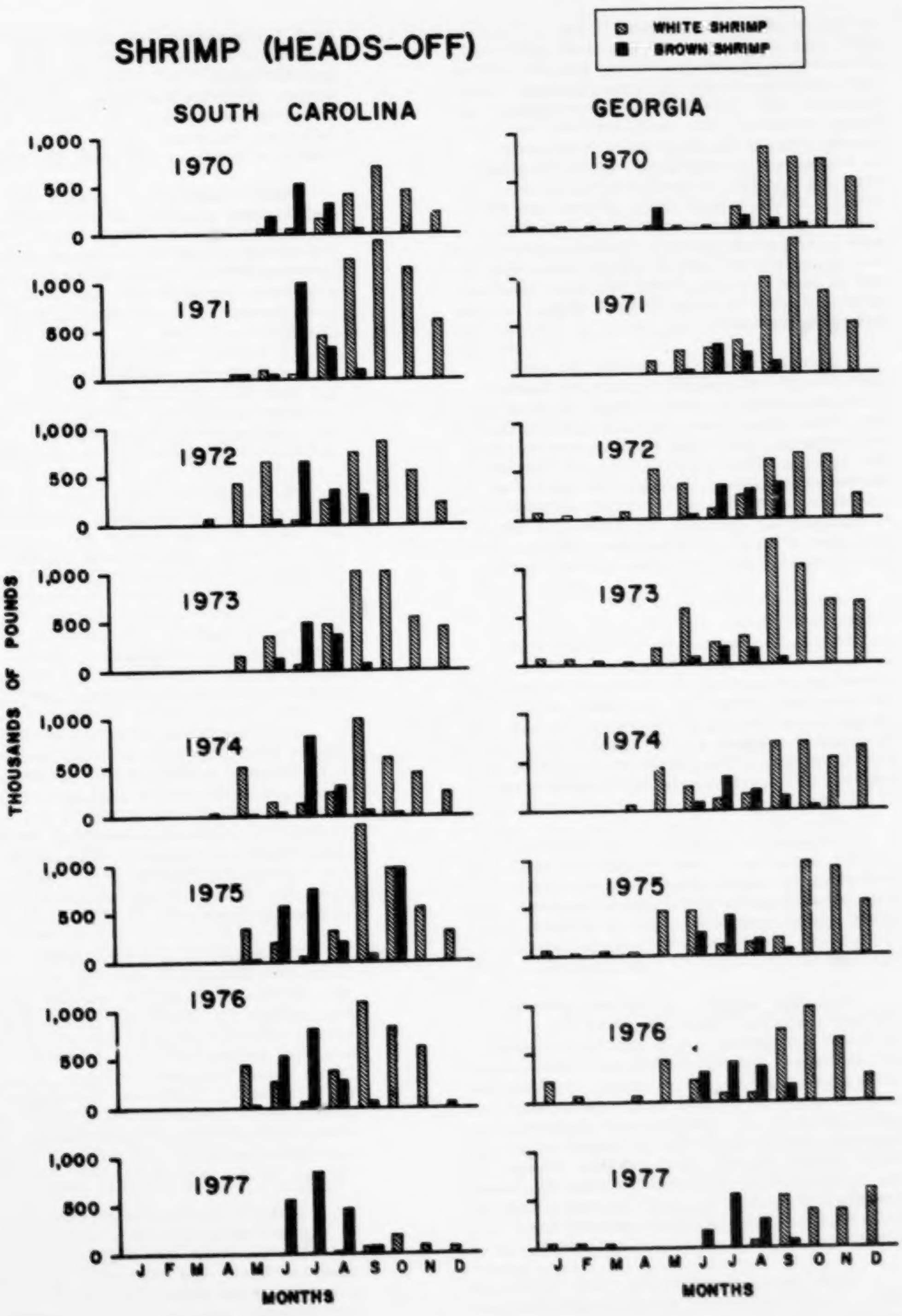

Figure 7-3. Landings of white and brown shrimp in South Carolina and Georgia, 1970 - 1977 (U.S. Department of Commerce, NOAA 1971 - 1980).

is apt to increase. While it is difficult to assess the total effect that alterations of coastal areas may have on the stability of shrimp resources, a study by Mock (1967) in Galveston Bay, Texas, suggests that such activity may be significant in decreasing production. In comparing an unaltered estuarine area with one altered by bulkheading, Mock found 2.5 times more brown shrimp and 14 times more white shrimp in the natural area. Estuarine nursery grounds are vital to postlarval and juvenile penaeids, and extensive alterations of these habitats may lead to a decline in this valuable resource.

Another cause for concern is pesticide introduction into estuarine habitats from agricultural runoff, some of which may cause significant mortalities among crustaceans, including penaeid shrimp. For example, Conte and Parker (1971) observed mortalities of 14% - 80% of juvenile brown and white shrimp exposed to malathion. Studies are needed to detail the effects of other pesticides, including DDT and mirex, on penaeids.

A considerable body of literature exists concerning the effects of physical parameters on the survival of postlarval and juvenile shrimp. These effects appear to adequately account for much of the observed variation in annual catches (Gunter and Edwards 1969, Berry 1970, Ford and St. Amant 1971). It is not known, however, how nonextreme climatological factors may affect the abundance of shrimp.

A number of other factors influencing the dynamics of shrimp populations, including diseases and parasites, and the interactions between penaeids and other marine organisms such as fishes, birds, and other decapod crustaceans, are beyond the scope of this volume.

b. The Fishery. Fishermen have exploited shrimp at least since 1817, although commercial catch statistics were not collected and published until 1880. Initially, dipnets, haul seines, and cast nets were the principal gear used. However, between 1912 and 1915, fishermen began to use otter trawls. The otter trawl became the standard gear by 1917, and by the 1930's accounted for approximately 90% of the catch. The remaining 10% was taken by cast nets and seines (McKenzie 1974).

Early motorized fishing craft were small, open skiffs powered with gasoline engines. During the 1920's and 1930's, vessels were decked over, engines placed forward, a pilot house added, and the diesel engine was introduced. Since then, the design of shrimp vessels and boats in the South Atlantic has been strongly influenced by vessels designed to fish along Florida and in the Gulf of Mexico. At the present time, most vessels are double-rigged for towing two nets simultaneously. An exception to this is smaller boats that fish in the bays and sounds of South Carolina. These boats are usually equipped with power winches and rope towlines and are rigged for towing a single trawl from the stern.

Most commercial trawlers use a flat or two-seam balloon net to fish for brown shrimp, whereas four-seam semi-balloon nets are often preferred for white shrimp (Rhodes 1974a). White shrimp are generally caught during daylight, while brown and pink shrimp are harvested mainly at night.

Most fishing trips last 1 or 2 days and most fishing grounds are located within 6 mi (9.7 km) of shore. There is no significant offshore fishery comparable to that in the Gulf of Mexico.

Although the otter trawl is the dominant commercial gear, some shrimp are taken by haul seines and by cast, butterfly, drop, push, and channel nets. Channel nets are effective for harvesting pink shrimp in North Carolina and white shrimp in South Carolina. However, the use of channel nets is strongly opposed by trawl fishermen in South Carolina and their use in the State is restricted to certain areas and seasons.

Pink shrimp are harvested in the spring between April and June and in the fall between September and November. Brown shrimp are most abundant from mid-June to mid-August. There is a spring fishery for white "roe" shrimp in May and June, and their progeny form the basis of the fall fishery which occurs primarily from September through December, when seasons generally close (McKenzie 1974).

St. Helena, Port Royal, and Calibogue sounds, as well as Bulls Bay, are the most productive inshore shrimping grounds in South Carolina. Offshore waters within 6 mi (9.7 km) of the beach are most productive from Bulls Bay to Tybee Roads. Wassaw, Ossabaw, Sapelo, St. Simons, St. Andrews, and Cumberland sounds are the most productive inshore areas in Georgia. Offshore waters from nearshore out to 5 to 7 mi (8.0 to 11.3 km) are quite productive.

Shrimp fishermen engage in a number of other fisheries during the off season. In South Carolina and Georgia, they may fish for black sea bass with traps or trawl for blue crabs. Others may fish for demersal species such as snapper, grouper, grunts, and porgy.

Recreational shrimping is widespread and probably accounts for 10% to 15% of the total catch of shrimp in the region. However, because of the lack of recreational catch statistics, it is very difficult to document either the catch or the value of this segment of the fishery.

Nonetheless, a recent survey of this recreational fishery indicated that over 300,000 angler days were spent annually in this region in pursuit of shrimp (Eldridge et al. 1974).

c. Landing Trends.

(1) General. Shrimp landings fluctuate markedly from year to year, and one must proceed with caution when attempting to describe trends in catches. Catch trends are similar for both States, suggesting that regional climatic conditions may have a profound effect upon the abundance of shrimp. In addition, catch statistics, particularly those prior to 1957, are only approximate. However, three trends appear to be real: 1) the decline in white shrimp landings between the 1927 - 1940 and 1950 - 1972 periods; 2) the change in distribution of landings among States; 3) commercial landings have been relatively stable since 1955 in the South Carolina-Georgia region.

(2) South Carolina. Data in Table 7-1 suggest that white shrimp were not exploited extensively in South Carolina until 1938. This is supported by Anderson et al. (1949), who reported that the low price of shrimp during depression years provided little incentive for fishermen. Landings of shrimp prior to 1940 do not appear to accurately represent abundance during that period. The lack of catch statistics for most of the 1940's makes it impossible to document the abundance of shrimp for that period. Since 1957, shrimp landings have been documented by species (Table 7-4), and these data show that annual landings of heads-off white shrimp have ranged from 183,675 lb (83,313 kg) in 1963 to 5,194,397 lb (2,356,126 kg) in 1971. The 1977 white shrimp figures reflect the severe winter weather conditions experienced in South Carolina (Farmer and Whitaker 1978). Brown shrimp landings have ranged from 526,869 lb (238,982 kg) in 1961 to 2,243,892 lb (1,017,807 kg) in 1962 (Table 7-4).

Data in Tables 7-1 and 7-4 suggest that: 1) whereas the abundance of white shrimp was relatively low between 1963 and 1966 (1965 excepted), their abundance since 1968 has been quite high, especially since 1971; and 2) while the bulk of brown shrimp landings occur in July and August, substantial landings of browns have occurred in September and October, particularly in those years when the abundance of white shrimp has been well below normal.

(3) Georgia. Shrimp catches increased sharply after 1918 and remained quite high through 1930 (Table 7-1). Landings were depressed during the 1931 to 1934 period because dealers limited the amount of shrimp that a vessel could unload (W. W. Anderson, 1973, Georgia Department of Natural Resources, Brunswick, pers. comm.). Landings were quite high from 1936 - 1940 and apparently a record catch was produced in 1945. Data are missing from most of the 1940's.

Since 1957, the catch of heads-off white shrimp has ranged from 2,269,950 lb (1,029,632 kg) in 1963 to 50,068,825 lb (2,299,180 kg) in 1968 (Table 7-4). Although the winter of 1977 did affect white shrimp production in Georgia, the effects were not as drastic as in South Carolina. Landings of heads-off brown shrimp ranged from 377,737 lb (171,338 kg) in 1973 to 2,110,880 lb (957,474 kg) in 1958.

Historical data (Tables 7-1 and 7-4) suggest that: 1) a significant decline in abundance of white shrimp occurred sometime between 1940 and 1957; 2) as with South Carolina, there appears to have been an increase in abundance of white shrimp from the early 1960's to the present time; and 3) although landings of brown shrimp have declined in both South Carolina and Georgia since 1967, the decline in Georgia may have been more severe.

The stability of the Southeastern Atlantic shrimp fishery since 1955 is reflected in Table 7-1. Landings during this period have averaged over 24 million lb (10.9 million kg) annually. The major cause of the annual fluctuations in landings appears to be changes in abundance of white shrimp (Anderson 1970). As noted by Anderson, the abundance of white shrimp appeared to decline in the early 1960's. However, landings of shrimp have increased in recent years, and it is possible that if the magnitude of the bait and recreational fisheries were known, the total catch of shrimp might be comparable to that experienced in the 1953 - 1957 period.

d. Operating Unit Data. Tables 7-5 and 7-6 list number of fishermen, number of vessels, gross tonnage of vessels, and quantity of otter trawl gear used in the South Carolina-Georgia shrimp fishery since 1950. Data for earlier years are lacking. In general, the total number of fishermen and number of vessels have not fluctuated greatly. However, the gross tonnage and yards of shrimp net have increased considerably over this period. This suggests that newer, more efficient vessels have replaced older, smaller vessels. This is supported by a report by Osterbind and Pantier (1965), which concluded that while the number of vessels increased by one-third from 1950 to 1959 in the entire shrimp fishery, the total tonnage capacity of the vessels more than doubled.

Tables 7-7 and 7-8 show three crude indices of mean annual catch per operating unit. These data suggest that each index declined significantly between the

Table 7-4. **Comparative shrimp landings (heads-off) for South Carolina and Georgia commercial species, 1957 - 1977 (Lyles 1967; U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).**

	SOUTH CAROLINA	GEORGIA
1957		
brown	1,443,133	912,094
pink	5,700	15,481
white	2,533,074	4,270,689
royal red		5,212
1958		
brown	2,000,466	2,110,880
pink		6,496
white	1,461,032	3,069,618
1959		
brown	1,813,631	1,133,204
pink		475
white	2,659,317	3,387,159
royal red		4,000
1960		
brown	1,430,690	1,274,330
pink		
white	3,349,393	4,917,880
1961		
brown	526,869	347,816
pink		
white	1,798,603	3,705,799
1962		
brown	2,243,892	1,837,501
pink		
white	1,858,097	3,586,488
royal red		71,111
1963		
brown	1,191,204	1,175,602
pink		
white	183,675	2,269,950
royal red		32,742
1964		
brown	1,139,318	1,221,485
pink		7,100
white	516,011	2,541,272
royal red		25,444
1965		
brown	1,554,428	1,203,379
pink		
white	2,787,023	4,315,722
royal red		664
1966		
brown	2,151,235	1,377,787
pink		1,149
white	519,423	2,763,460
royal red		
1967		
brown	1,463,377	1,126,382
pink		
white	1,124,753	3,132,982
royal red		10,444

Table 7-4. Concluded

	SOUTH CAROLINA	GEORGIA
1968		
brown	963,093	453,064
pink	3,800	
white	3,102,002	5,068,825
royal red		
1969		
brown	795,226	559,454
pink		
white	2,977,273	4,900,279
royal red		
1970		
brown	1,160,420	633,802
pink		775
white	2,001,730	3,230,167
royal red		
1971		
brown	1,710,094	716,047
pink		
white	5,194,397	5,006,227
royal red		
1972		
brown	1,395,522	1,058,507
pink		
white	3,790,630	3,606,302
royal red		
1973		
brown	1,067,868	377,737
pink		
white	4,244,717	4,960,773
royal red		
1974		
brown	1,290,669	878,823
white	3,474,689	3,774,285
1975		
brown	1,478,843	804,964
pink	7,161	5,520
white	1,203,717	4,380,028
royal red		20,255
1976		
brown	1,716,151	1,169,670
pink	19,742	
white	3,804,334	3,823,681
1977		
brown	2,043,878	991,171
pink	30,306	4,196
white	433,726	1,942,718
rock	194,019	

Table 7-5. Operating unit data for otter trawls in the South Carolina shrimp fishery, 1950 - 1975 (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

YEAR	TOTAL FISHERMEN	NUMBER OF VESSELS	GROSS TONNAGE (ALL VESSELS)	YARDS AT MOUTH OF TRAWL (TOTAL ALL VESSELS)
1950	453	225	1,690[a]	4,498
1951	977	481	3,937	9,902
1952	694	345	2,525	7,029
1953	718	357	2,695	7,137
1954	575	287	1,489	5,683
1955	730	363	3,648	7,283
1956	826	400	4,159	7,818
1957	989	477	5,445	9,746
1958	951	465	4,406	9,975
1959	812	431	3,433	9,352
1960	819	440	7,368	9,941
1961	702	357	5,972	8,711
1962	740	383	6,229	9,708
1963	665	327	5,762	9,361
1964	503	246	4,677	7,319
1965	489	239	5,318	7,751
1966	442	216	5,018	7,770
1967	476	233	6,218	8,064
1968	633	303	8,514	10,297
1969	718	346	10,967	11,500
1970	642	314	10,697	10,657
1971	874	426	15,436	13,759
1972	938	523	15,223	
1973	993	538	16,183	
1974	1,164	591	19,437	
1975	1,218	612	19,725	
TOTAL	19,741	9,925	196,171	193,261

a. Net tonnage

1927 - 1940 and 1950 - 1970 periods. Part of the decline appears to be a direct result of the change in abundance of white shrimp between the two periods. The average catch per operating unit indices from 1955 - 1970 have remained rather stable, apparently fluctuating in response to variations in annual landings. These data suggest that since 1955 the total abundance of shrimp has remained reasonably stable, although pronounced fluctuations have occurred from year to year.

e. Economics. Although the shrimp fishery of the Southeastern United States is structured rather simply, this structure becomes more complex when the various elements and relationships affecting its performance and economic viability are considered. The fishery has several separate and distinct parts, each of which is influenced by a differing set of economic forces. It consists of a large number of producers or harvesters, a small number of well-established dockside dealer/wholesalers, a small number of processors, few effective middlemen (brokers, wholesale distributors, etc.), few major retail outlets drawing directly on the fishery, and a limited product storage capacity. It is a traditionally market oriented system that is motivated by relationships among individuals and reductions of uncertainty, rather than a market that has been willing to expand and explore such advances as new marketing arrangements and new product forms. As a result, it is a market that lacks supporting services and facilities and that has, in essence, closed the door to many marketing channels.

Landings of shrimp in the Sea Island Coastal Region are influenced by factors

Table 7-6. **Operating unit data for otter trawls in the Georgia shrimp fishery, 1950 - 1975 (U.S. Department of Interior, Fish and Wildlife Service 1942 -1969; U.S. Department of Commerce, NOAA 1971 - 1980).**

YEAR	TOTAL FISHERMEN	NUMBER OF VESSELS	GROSS TONNAGE (ALL VESSELS)	YARDS AT MOUTH OF TRAWL (TOTAL ALL VESSELS)
1950	613	304	2,392[a]	6,155
1951	660	323	3,151	6,603
1952	563	277	2,797	5,673
1953	502	249	2,469	4,942
1954	506	253	3,006	4,802
1955	587	286	2,748	5,286
1956	713	367	4,129	7,230
1957	793	427	3,596	7,621
1958	1,096	580	4,575	10,148
1959	1,106	594	4,618	10,134
1960	953	502	8,433	8,969
1961	1,092	582	9,027	9,587
1962	1,177	632	9,421	10,045
1963	1,156	627	10,523	12,343
1964	1,104	546	10,343	11,048
1965	1,095	607	10,570	12,419
1966	1,079	610	10,430	12,346
1967	1,076	602	11,812	13,024
1968	1,139	650	14,286	14,567
1969	1,219	688	17,196	16,196
1970	1,003	574	12,744	13,154
1971	1,277	699	18,840	17,386
1972	1,231	657	17,370	
1973	1,218	654	16,884	
1974	1,406	722	21,521	
1975	1,530	766	23,763	
TOTAL	25,894	13,778	256,644	219,678

a. Net tonnage

affecting: 1) biological abundance of commercial species, and 2) fishing effort. Total supply of shrimp for the United States market is dependent on the domestic catch and imports. Demand is dependent on such factors as retail price, consumer income, and the influence of other seafoods and meats. The price received by harvesters is a function of the retail price minus the costs of selling shrimp through the market system.

(1) The Landing Market. Although fishermen or harvesters are usually not viewed as components of market distribution channels, they determine the product available to other distribution channels. As such, it is important to understand the major forces influencing them and their general economic viability.

The typical fishing unit, with some exceptions, is the boat-unit with owner and crew sharing the proceeds and certain trip costs. In addition, there are multiple boat-units, some of which are owned by a few vertically integrated firms which in various operations, such as catch, processing, and merchandising, are combined. It is generally agreed that multiple boat-units make up a small percentage of the vessels in the shrimp fishery and that these have been declining over the past 10 years. Unfortunately, there is no readily available information to substantiate this concensus. However, it appears reasonable at present to accept the owner-operated boat-unit as representative of the landing market.

Landings involve more than biological abundance, weather, and catch. Also

Table 7-7. Crude annual indices of catch per unit effort in South Carolina, 1927 - 1971 (U.S. Department of Commerce, Bureau of Fisheries 1927 - 1941; U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

YEAR	CATCH PER VESSEL (POUNDS)	CATCH PER FISHERMAN (POUNDS)	CATCH PER 100 YARDS OF OTTER TRAWL (POUNDS)
1927	59,183	29,591	309,165
1928	47,937	23,968	95,241
1929	11,987	4,426	59,691
1930	22,020	10,295	117,442
1931	43,922	21,082	209,154
1932	53,595[a]	25,435[a]	267,980[a]
1934	40,940	19,580	178,533
1936	36,242	15,856	170,268
1937	29,530	12,940	144,868
1938	91,297	38,040	448,636
1939	57,415	23,700	239,653
1940	32,814	12,391	146,567
1945	24,174	11,383	103,075
1950	34,428	17,100	172,219
1951	7,755	3,818	37,674
1952	11,803	5,867	57,936
1953	14,245	7,083	71,257
1954	23,149	11,554	116,907
1955	19,034	9,465	94,872
1956	13,831	6,697	70,766
1957	13,845	6,677	67,764
1958	12,355	6,041	57,596
1959	17,162	9,109	79,096
1960	17,967	9,652	79,525
1961	10,880	5,533	44,592
1962	16,804	8,697	66,297
1963	6,725	3,306	23,492
1964	10,556	5,162	35,482
1965	27,994	13,682	86,254
1966	19,406	9,483	53,949
1967	17,176	8,407	49,630
1968	20,622	9,871	60,683
1969	16,812	8,101	50,583
1970	15,767	7,711	46,457
1971	25,240	12,302	78,150

a. Finfish included.

important are ability and availability of crew, owner-crew relationships, and condition of the vessel. Landings appear to be related more closely to biological abundance and weather than to price (Batey 1974). There is no evidence of any attempt by fishermen to influence prices by deliberate variation in quantities landed. In fact, some preliminary unpublished studies on break-even prices indicated that some larger trawlers may shrimp regularly when it is not justified by price. The decision to shrimp or not to shrimp apparently revolves around the captain's expectations of poundage. If the captain feels that shrimp are relatively scarce, he may decide not to shrimp or to fish for crabs or some other species instead. The decision to trawl for crabs or finfish appears to be determined almost solely by price, although no work has been done in the South Atlantic region on the attitudes and variables determining such decisions. As a result, quantity landed may be viewed as largely independent of price variables within a given season.

Knowledge of the landing's market, long run supply conditions, and the effect of alternative management policies on the fishery requires an understanding of the economic conditions of boat-units in the fishery and cognizance of any trends that

Table 7-8. Crude annual indices of catch per unit effort in Georgia, 1927 - 1971 (U.S. Department of Commerce, Bureau of Fisheries 1927 - 1941; U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

YEAR	CATCH PER VESSEL (POUNDS)	CATCH PER FISHERMAN (POUNDS)	CATCH PER 100 YARDS OF OTTER TRAWL (POUNDS)
1927	65,318	32,659	326,595
1928	40,025	19,322	72,304
1929	74,117	35,877	349,059
1930	44,710	25,365	234,571
1931	34,194[a]	16,578[a]	165,790[a]
1932	28,812[a]	14,406[a]	143,489[a]
1934	45,925	22,885	210,680
1936	54,885	25,837	251,679
1937	38,791	18,819	202,815
1938	45,527	21,765	223,872
1939	50,712	23,229	212,760
1940	46,445	19,530	202,111
1945	60,265	27,830	237,567
1950	36,699	18,200	181,262
1951	23,554	11,527	115,220
1952	21,628	10,641	105,605
1953	30,261	15,010	152,473
1954	30,598	15,299	161,210
1955	25,038	12,199	135,469
1956	21,773	11,207	110,523
1957	20,580	11,081	115,313
1958	15,072	7,976	86,147
1959	12,790	6,869	74,970
1960	20,710	10,909	115,916
1961	11,695	6,233	70,998
1962	13,614	7,310	85,660
1963	8,681	4,708	44,099
1964	10,876	5,379	53,752
1965	14,143	7,804	69,130
1966	10,616	6,001	52,453
1967	11,058	6,186	51,115
1968	13,131	7,493	58,595
1969	12,277	6,929	52,155
1970	10,446	5,978	45,584
1971	12,678	6,940	50,974

a. Finfish included.

appear to be developing. Unfortunately, data are not available to describe the current condition of the fishery in any definitive fashion, much less estimate trends.

Data on costs and returns were compiled from a 1970-71 South Carolina survey covering 23 vessels (Rhodes 1974a) and a 1965-66 survey of 50 Georgia vessels by Carley (1968a). Although limited in terms of the regional fishery, these two surveys provide a useful starting point. Although the Georgia and South Carolina surveys were conducted during different time periods, under very different price and cost conditions, and under somewhat different formats, the results were similar when cost items were compared as a percent of total costs. Combined results of the two studies are presented in Table 7-9.

As part of the South Carolina survey, efforts were made to show the costs and returns of some "better" trawlers in the fishery. In most fisheries, certain vessels generally record higher landings and returns over time. These vessels are important because they form the core of the fishery; information on their mode of operation would be useful in upgrading the general economic condition of the fishery.

Table 7-9. Average costs and returns for South Atlantic shrimp vessels (Carley 1968a, Rhodes 1974a).

ITEM	GEORGIA SURVEY (1965-66)[a]	GEORGIA AND SOUTH CAROLINA SURVEYS COMBINED[a,b]	FROM SOUTH CAROLINA SURVEY (1970-71)[b]: VESSELS GREATER THAN 55 FT
Vessels			
Number	50	73	14
Average Length (feet)	47.9	56.5	64
Average Landings (pounds)	30,160	54,564	75,384.00
Average Price/lb (cents)	0.667	0.84	0.95
GROSS RECEIPTS ($)	20,126.00	47,305.00	69,453.00
Average Variable Costs ($)			
Net Maintenance	622.00	873.00	1,512.00
Vessel Maintenance	2,683.00	1,789.00	4,166.00
Fuel and Lube	2,214.00	1,684.00	3,076.00
Ice	681.00	802.00	1,304.00
Groceries	1,200.00	456.00	748.00
License		104.00	140.00
Heading and Packing	1,534.00	4,214.00	7,998.00
Crew Share[c]	5,300.00	16,820.00	32,850.00
Other[d]	98.00	501.00	912.00
SUBTOTAL	14,332.00	35,073.00	52,706.00
Average Fixed Costs ($)			
Depreciation, taxes, insurance, interest[e]	2,038.00	5,499.00	7,052.00
Average TOTAL COSTS ($)	16,370.00	40,572.00	59,758.00
Average Net Return Before Taxes ($)	3,756.00	6,733.00	9,695.00

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a. Carley 1968a.
b. Rhodes 1974a.
c. Includes an inputed return for the Captain's share.
d. Includes miscellaneous items such as telephone, accounting and legal fees, office expenses, transportation, etc.
e. To make depreciation comparable for all vessels, straight line depreciation over a 10-year period was used.

As shown in Table 7-9, average landings were 30,160 lb (13,680.3 kg) for Georgia vessels, 54,564 lb (24,749.8 kg) for all vessels, and 75,384 lb (34,193.6 kg) for the larger vessels. Average incomes or return to the boat were $3,756, $6,733, and $9,695 respectively. By adding the return to the captain and the boat, an owner-operator's income before taxes averaged $16,320 for all vessels and $28,420 for the better trawlers. The 1971 season was a good season both in terms of price and quantity landed.

Total costs averaged $16,370 for Georgia vessels, $40,572 for the combined data, and $59,758 for the larger trawlers. Major cost items in the combined and larger trawler surveys in order of importance were crewshares, heading and packing, depreciation, net maintenance, and vessel maintenance. The Georgia survey differed substantially with crewshares, vessel maintenance, fuel and lubrication, ice and icing, and depreciation being the major items.

South Carolina vessels on the average in 1971 fared considerably better than Georgia vessels in the 1965-66 period (Table 7-9). How much of this difference is due to different price-cost relationships, biological abundance, sampling technique or other factors is unknown. Unfortunately, the South Carolina survey did not include enough vessels to provide detailed comparison of length categories. Some general statements regarding functional relationships affecting costs and returns can be made, however.

Fixed costs appear related to size and age of the vessel as well as the quantity and types of gear. These costs are greater in absolute terms for larger vessels, but when viewed as a percentage of total costs, they account for about the same relative share of total costs for all vessels.

Variable costs appear related to such components of effort as the size of the vessel, quantity of shrimp landed, and number of crew members. Such costs account for about 87% of total costs and, in terms of cash outlays, are greater for larger vessels.

As indicated in Tables 7-9, the higher cost of operating larger vessels is justified by returns in a "good year." Whether this would hold true in "bad years" is unknown. This is particularly important because a definite trend in Georgia toward larger vessels in the 1960 - 1965 period was noted by Carley (1968b). This trend appears to have continued to the present for the entire South Atlantic fishery. Carley (1968a) did not find a significant relationship between variable costs and vessel size. This appears, however, to be a function of his treating major repair costs as fixed costs. Additional relationships cannot be specified due to lack of data on such variables as horsepower and number of trips.

Between 1970 and 1975, the cost of running a Georgia shrimp trawler doubled from $25 per day to $50 per day (North et al. 1976). A survey of double-rigged shrimp vessels in 1971 showed that fuel, ice, and oil were 7% to 15% of the total operating costs (Rhodes 1974a). In 1974, fuel and ice costs were approximately 20% and 30% of operating costs (Roberts 1975). When supply exceeds demand, the shrimper can be caught in a "cost-price squeeze" (Miller et al. 1975).

In summary, the landings market level of the South Carolina and Georgia shrimp fishery, as in many other primary industries, appears to be composed of large numbers of very small part-time units that fish intermittently, depending on expectations, time available, etc.; a number of marginal units that move in and out of the fishery depending on price and biological abundance in a particular season; and a group of generally successful units that form the core of the fishery. However, the variables and attributes distinguishing successful and marginal producers have yet to be defined. It also appears that vessel owners, financial institutions, and others are optimistic about the shrimp fishery and are willing to invest additional resources in the industry at the time of this study. Future marketing and cost conditions may alter this attitude.

(2) Dockside Dealer-Wholesalers. The "dealer" is the primary wholesaler in the market system and is an important link in the chain of distribution channels. He is typically the first to receive shrimp from the harvester and, as such, determines the ex-vessel price. The dealer generally purchases shrimp for resale without further processing beyond sorting, grading, re-boxing, or re-icing. [illegible] cases, the dealer owns a boat or financially supports one or more boats which bring the dealer their catch. The overall importance of dealers in this role is not known.

The dealer also sells services (e.g., heading and packing, diesel fuel, gas, ice, etc.) to the boat-unit. The dealer purchases shrimp and sometimes other species from the boat-unit for sale to processors, secondary wholesalers, and other primary wholesalers. A few dealers bypass the wholesaler and sell directly to the retail level or maintain retail outlets of their own. Dealers, however, sell primarily to secondary wholesalers or processors. For example, 82% - 86% of the South Carolina landings are sold directly to the Fulton Fish Market or to processors in Georgia and Florida (South Carolina Marine Resources Division, 1979, Charleston, unpubl. data). Trends in Georgia were approximately the same in 1966, with 88% of shrimp handled by dealers being sold to processors and secondary wholesalers (Carley 1968a).

Because they handle most of the shrimp landings; make decisions concerning sales to secondary wholesalers, primary wholesalers, processors, and retailers; and control the supply of essential services to boat-units; dockside dealer-wholesalers receive little competition for the purchase of shrimp from boat-units. Dealers form the initial assembly point for the product and determine the first step in the market channel. The dockside dealer-wholesaler level determines the shrimp market's traditional character. Inland wholesalers operate at the convenience of the dockside dealer-wholesalers, who control the local supply. Apparently, most dealers have done well in recent years and are unwilling to experiment with either new product forms or market channels. Another factor affecting this situation is the general lack of local freezer space. Although a recent unpublished South Carolina survey has indicated that "certainty of supply" is not as important in accessing higher market channels as once believed, capacity to store some minimum quantity of shrimp over time is required. The failure or inability of dealers to access higher market levels may severely limit ex-vessel price stabilization and increases.

(3) Market Channels for Shrimp. The market channels or combination of market levels involved in distributing shrimp and shrimp products to consumers are diverse. Figure 7-4 outlines the major market channels for shrimp landed in the region (Carley 1968a).

Most shrimp landed in the region (approximately 90%) are sold to dockside dealer-wholesalers. They in turn sell heads-off shrimp to four types of buyers: processors, secondary wholesalers, brokers, and retail outlets. In the aforementioned Georgia study, 55% of coastal dealer sales were to processors, 33% to secondary wholesalers, 9% to retail outlets, and 3% to brokers (Carley 1968a). The 1971 South Carolina survey (Rhodes 1974a) indicated dealer sales as follows: 36% to secondary wholesalers, 56% to processors, 7% to retail outlets, and 1% to brokers. Results of the two surveys are obviously similar. It is noteworthy that in South Carolina 81% of sales to secondary wholesalers are outside of the South Atlantic region. In Georgia, an estimated 34% of sales to secondary wholesalers are outside of the region. Note that Figure 7-4 illustrates the market channels for shrimp landed in the region, not for all shrimp marketed in the region. Large quantities of shrimp are imported into the region at the processor, wholesaler, and broker levels.

(4) Value-Added Analysis. The standard criterion for measuring the size of the industry in the region has been the value of the catch received by fishermen. A more complete determination of the size of the total industry in terms of dollars, however, is the value added at each stage of production and marketing. The purpose of a value-added analysis is to measure the contribution to the final value of shrimp at each stage of the production and marketing process. The price of shrimp at the point of its sale to the ultimate consumer is the total value that is available to the various activities involved in moving the product from the boat to the consumer. This analysis includes payments for materials, labor, equipment, and other costs, plus profits that accrue to the various production and marketing activities. Value-added data are useful in describing the market system and for providing a base for analysis of market efficiency (Laurent et al. 1975).

Only crude estimates of value-added analysis are available for the South Atlantic. A 1965-66 Georgia study estimated that the value of shrimp to crew and vessel owners was $0.57 per pound and the estimated value of shrimp at the wholesale level was $1.19 per pound, an increase of $0.62 in value accruing to the various functions involved in moving shrimp from the vessel to the wholesale level (Carley 1968a). Thus, fishermen received an estimated 48% of the wholesale value and the marketing functions received about 52% of the wholesale value. The 1971 South Carolina survey indicated that the wholesale share of value had increased to about 60% (Rhodes 1974a).

Table 7-10 provides estimates on a national basis for price spreads and markups at the ex-vessel, wholesale, and retail levels for the years 1966 - 1971. These data indicate that the fisherman's share of the retail price of shrimp has varied widely since 1966. In general, however, the fisherman's share has dropped well below the 50% received in 1966. Conversely, there appears to be a definite upward trend in the markup at the wholesale level. These figures should be considered as rough estimates. None of the sources surveyed had complete information on the percentages of shrimp moving through each marketing channel. The difficulty of generating definitive estimates of value added is further complicated in that quantities and prices vary seasonally and annually. It is important, however, to begin to develop estimates of value-added, as this provides a basis for analyzing the marketing system and for estimating the contribution of the shrimp industry to the

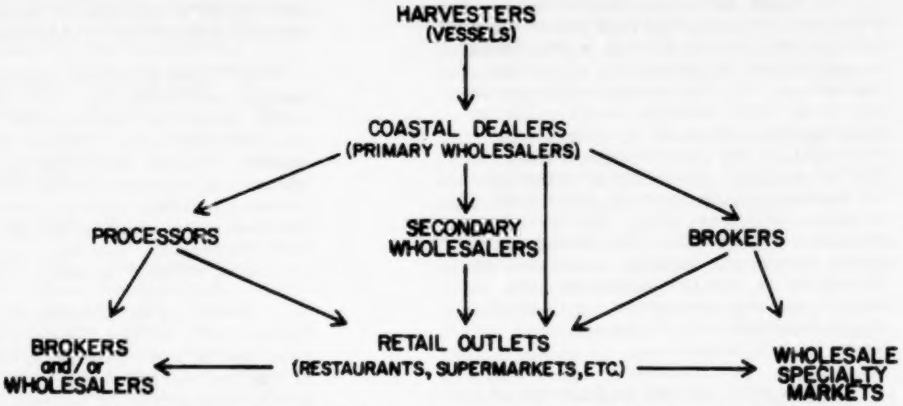
HARVESTERS
(VESSELS)
COASTAL DEALERS
(PRIMARY WHOLESALERS)
PROCESSORS
SECONDARY WHOLESALERS
BROKERS
BROKERS and/or WHOLESALERS
RETAIL OUTLETS
(RESTAURANTS, SUPERMARKETS, ETC.)
WHOLESALE SPECIALTY MARKETS

Figure 7-4. Market channels for shrimp landed in the South Carolina-Georgia seafood industry. Does not include all shrimp marketed in the region (Carley 1968a).

Table 7-10. Fresh and frozen shrimp prices on a national basis at three market levels, fisherman's share at retail level, and markups at two market levels, 1966 - 1971 (Laurent et al. 1975).

	PRICES (CENTS/LB)			MARK-UPS (PERCENT)		
Year	Ex-vessel[a]	Wholesale	Retail	Fisherman's Share Of Retail Price (Percent)	Wholesale	Retail
1966	65.0	110	128	50	40	14
1967	54.5	107	136	40	49	21
1968	62.4	120	135	46	48	11
1969	63.8	131	153	41	51	43
1970	57.9	126	163	35	54	23
1971	70.5	151	167	42	53	10

a. Heads-off weight basis of all shrimp landed.

South Atlantic region.

f. Conservation and Management Policies. Laws and regulations pertaining to the shrimp fisheries in Georgia and South Carolina have been designed to control seasons, fishing areas, and the size of shrimp that can be legally harvested (Bearden 1974). Historically, the regulation of fishing areas was largely aimed at the protection of critical nursery areas and brood stocks. The size of shrimp that can be harvested is controlled to a significant extent by restrictions on seasons and fishing areas, as well as by regulations on gear and methods.

The future harvest of shrimp is generally considered independent of the current year's population (Calder et al. 1974); consequently, in recent years the importance of protecting or conserving subadult and "roe" shrimp has been deemphasized in both States when considering fishing seasons. Emphasis is now placed upon optimizing the economic yield of the fishery (Farmer et al. 1977).

In South Carolina, the Marine Resources Division of the South Carolina Wildlife and Marine Resources Department is authorized to promulgate rules and regulations for the control of fisheries consistent with existing State policies and statutes. Most of the regulatory authority of the Department is specified by statute, including provisions for seasons, areas, gear restrictions, licenses and taxes, etc. The Division does have considerable flexibility in shrimp management insofar as control of the season in coastal waters is concerned, and any area where legal trawling is permitted may be opened or closed at any time.

The Coastal Resources Division of the Georgia Department of Natural Resources is the organizational unit primarily responsible for coastal fisheries management and enforcement in that State. As in South Carolina, much of the regulatory authorization is specified by State legislation. Georgia statutes pertaining to shrimp allow some flexibility in the opening and closing of seasons, based on count sizes. Other aspects relating to vessel licenses, gear restrictions, etc., are specified by statute.

In South Carolina, the opening and closing of estuarine and inshore legal trawling grounds depend upon the results of shrimp population sampling by the Division (Farmer et al. 1977). Similar sampling is performed in Georgia. Georgia's waters can be opened between June 1 and December 31, provided that the shrimp count is 45 or less to the pound (heads-on).

Starting in 1978, Georgia's sounds were completely closed to commercial trawling (Georgia Department of Natural Resources 1978). Georgia's Coastal Resources Division has supported the closure of Georgia's sounds because past openings have apparently intensified harvesting costs by concentrating fishing effort spatially and temporally on sub-optimal sized shrimp (R. K. Mahood, 1978 Georgia Department of Natural Resources, Brunswick, pers. comm.).

While it may be difficult to improve the long-run economic yield of penaeid shrimp fisheries (Anderson 1977), policy makers in both States feel that the alteration and/or destruction of the coastal estuaries will ultimately be the critical factor in determining the fate of shrimp as a viable resource in the South Atlantic States (Eldridge 1974). Estuarine nursery grounds are vital to postlarval and juvenile penaeids, and extensive alterations of these habitats may initiate a decline in this valuable resource. Shrimp management programs can only succeed if safeguards are taken by appropriate governmental agencies to maintain adequate nursery grounds for this valuable resource.

g. Prospects and Potentials. The Georgia and South Carolina shrimp fisheries appear to have reached a plateau of production after periods of relative growth. Unless extensive new grounds are discovered offshore or unless prices increase to offset rising costs and make it worthwhile to trawl existing grounds much more thoroughly, landings are expected to remain at present levels.

According to Eldridge (1974), three factors will affect future commercial landings in the South Atlantic region: 1) the recreational catch of shrimp; 2) the harvesting of under-exploited species, such as rock shrimp; and 3) the extent of coastal alteration projects which adversely affect nursery grounds.

The recreational catch of shrimp probably represents an important portion of the total catch in South Carolina and Georgia where "weekend trawlers" (small runabouts with try nets) fish the creeks, sounds, and bays, often illegally. The effect of increases in the recreational shrimp fishery on the commercial landings is unknown.

Increased effort in harvesting of under-exploited species could substantially affect future landings. During the off-season or during periods of low productivity in the regular shrimping season, fishermen have fished the deeper continental shelf zone for rock shrimp and calico scallops, although this does not constitute a significant off-season fishery as yet.

As discussed previously, the future biological yield of shrimp in the study area may be influenced by the rate of coastal alteration and destruction of nursery grounds. Estuaries are being subjected to an ever-increasing array of stresses, ranging from increased levels of human and industrial pollution to direct loss of marsh areas due to channelization projects and spoil deposition. Chapman (1968) observed that 200,000 acres (80,939 ha) of shallow coastal bays had been dredged and filled in the Southeast and Gulf States during the previous 20 years. Trent et al. (1972) noted that demand for water-front housing, which frequently involves dredging, filling, and bulkheading, is apt to increase.

If the penaeid fisheries in Georgia and South Carolina are evolving to an open access equilibrium as some suspect (e.g., Jones 1977), then declining profitability by individual shrimpers will be characteristic of future trends. Diversification into the offseason harvesting of other species may be a means to reduce the risk of depending upon shrimp revenue to meet vessel fixed costs. In addition, studies in South Carolina and Georgia suggest that economies of scale associated with a modern seafood industrial park would also aid shrimpers in reducing their operating costs. In general, the physical and economic productivity of the shrimp fisheries in South Carolina and Georgia are not expected to improve significantly in the future.

2. The Blue Crab Fishery

a. The Resource. The commercial fishery for blue crabs (*Callinectes sapidus*) in South Carolina and Georgia is second to the shrimp fishery in terms of total economic value. Crab landings in each State have been comparable during recent years, ranging from about 7 million to 10 million lb (3.2 million to 4.5 million kg) annually (Fig. 7-5). The blue crab fishery is conducted primarily in estuarine waters with crab traps (pots) being the principal fishing gear in both States. Otter trawls are also used for harvesting blue crabs commercially in the region, especially during the winter months.

Since 1950, blue crab landings in both Georgia and South Carolina have fluctuated considerably from year to year (Table 7-1). These fluctuations are the result of environmental factors influencing growth and survival (as is the case with shrimp and other short-lived fishery resources), and to some extent, economic factors (price, labor supply, etc.). Although blue crab landings declined during the 1960's, reaching a low in 1968, landings became fairly stable from 1968 - 1976, and then increased somewhat during 1977. In 1978, blue crab production increased significantly, and the total catch for both States amounted to about 20 million lb (9.1 million kg) (Bell and Fitzgibbon 1978). (See Atlas plate 44 for a comparison of blue crab landings by area within each State.)

Although the general life history of the blue crab is fairly well known, such factors as growth and mortality rates, movements and migrations, etc. are largely undetermined within South Carolina and Georgia. In the characterization area, it has been speculated (Eldridge and Waltz 1977) that some crabs hatched in early spring may reach legal size (5 in or 125 mm) by fall and consequently are recruited into the commercial fishery during their first year. After the spring mating molt, female blue crabs move seaward into deeper and/or higher salinity waters (McKenzie 1970). In South Carolina and Georgia, blue crabs are harvested with traps in tidal streams, inland and away from areas where there are higher female concentrations. Eldridge and Waltz (1977) observed that South Carolina crab pot catches average about 72% male and 24% mature females. In contrast, crab trawling results in a higher percentage of females in the catch (Palmer 1974, Eldridge and Waltz 1977). Reported crab trawl catches have been composed of up to 84% female blue crabs (Eldridge and Waltz 1977).

Very little is known about blue crab population dynamics. As with penaeid shrimp, there is generally assumed to be a weak parent-progeny relationship. Van Engel (1978) has speculated that annual fluctuations in blue crab abundance are associated with climatic factors which influence distribution, larval and juvenile growth, and general survival. McKenzie (1970) and Mahood et al. (1970) suspected the influence of pesticides on some fluctuations (e.g., 1968) in blue crab populations in Georgia and South Carolina. Recent interpretations by Rhodes et al. (1977a) and R. K. Mahood (1978, Georgia Department of Natural Resources, Brunswick, pers. comm.) suggest there may be cyclic changes in annual blue crab abundance. Unlike white shrimp, blue crab survival does not seem to be severely affected by low winter temperatures in South Carolina and Georgia. The 1977 and 1978 blue crab catch was significantly higher than in previous years, despite the low water temperatures during the 1976-77 and 1977-78 winters.

Fishery management practices related specifically to blue crabs are quite limited in the two States. Protection of juveniles and estuarine nursery habitat appears to be the most significant conservation measure now in effect in both States. Due to a lack of adequate information on blue crab catch per unit effort, population dynamics, etc., more sophisticated management techniques are not possible at this time.

b. The Fishery.

(1) Crab Traps. During the 1950's, the crab trap (pot) became the major fixed gear for commercial harvesting of blue crabs in South Carolina and Georgia. The blue crab trap is made of heavy galvanized or PVC-coated poultry wire. Traps used in South Carolina are similar to the Lewis trap as described by Van Engel (1962), except that the "Carolina Trap" is usually several inches shorter in height (Rhodes 1974b). Traps are often set in a pattern following the contour of the river, with one buoy per trap. All crab trapping in South Carolina and Georgia takes place in estuarine waters (tidal streams, sounds, etc.).

Fishing techniques are similar to those described by Van Engel (1962). Fishermen usually reach their traps in the morning, unload the crab catch, bait and return the traps to the water. In most cases, commercial size crabs are loaded into 55-gallon drums or other containers and hauled to wholesalers or processors. During summer months, a fisherman may

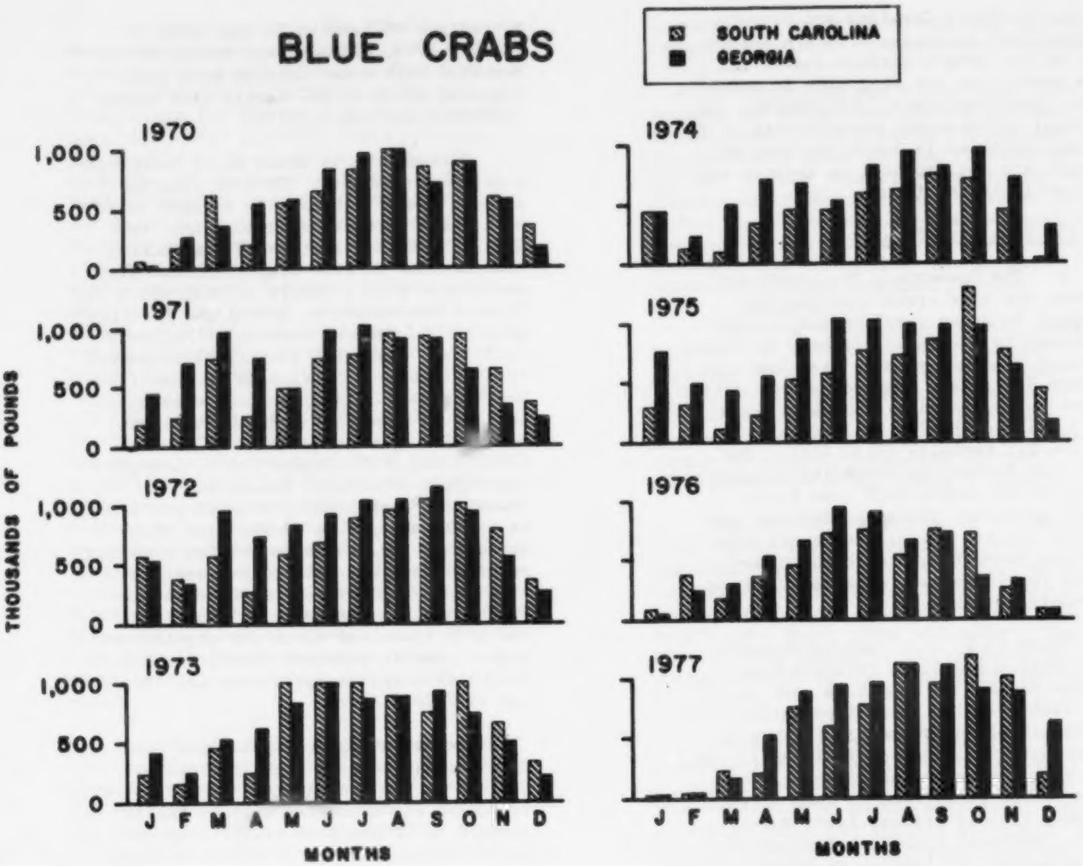

Figure 7-5. Monthly commercial blue crab production for South Carolina and Georgia, 1970 - 1977 (U.S. Department of Commerce, NOAA 1971 - 1980).

return to his traps during the afternoon to empty them a second time (Rhodes 1973). In 1975, crab traps accounted for 83.5% of the total blue crab catch in Georgia and 100% in South Carolina (Table 7-11).

(2) Crab Trawls. The gear and techniques for crab trawling have been described by Cummins and Rivers (1962). Crab trawling in nearshore marine waters comprised a large percentage of the total Georgia catch during the 1960's (Table 7-11). In South Carolina, crab trawling is conducted in larger sounds and nearshore marine waters.

(3) Trot Lines. Crab trot lines were used extensively in South Carolina and Georgia up until the 1950's, when they were gradually replaced by the more efficient crab trap. Fishing methods and gear in this area were very similar to that described by Van Engel (1962). The use of trot lines today is quite limited since comparative studies like those of Walburg (1960) and Fischler (1965) have shown crab traps and otter trawls to be more efficient.

c. Seasons. The seasonal availability of blue crabs is determined largely by time of recruitment of legal size crabs into the estuarine waters. The timing of recruitment is a factor of water temperatures and movements during the year. During the winter months, when water temperatures fall below 50°F (10°C), blue crab trapping becomes less effective and fishing effort decreases or may cease altogether. During the same time, due to the seaward movement of adult females into deeper, more saline waters of coastal sounds and nearshore marine waters, crab trawling effort is at a maximum.

The seasonal patterns in crab pot catches probably reflect the general

Table 7-11. Annual blue crab catch (in thousands of pounds) by gear and percent of total landed in Georgia and South Carolina for selected years (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 -1980).

	GEORGIA				SOUTH CAROLINA			
Year	Traps	Crab Trawls	Shrimp Trawls	Dip Net & Trot Line	Traps	Crab Trawls	Shrimp Trawls	Trot Lines
1975	7,398 (83.5%)	476 (5.4%)	990 (11.2%)	0 (0)	6,579 (100 %)	0 (0)	1[a] ( )	0 (0)
1970	4,386 (61.8%)	709 (10.0%)	1,997 (28.2%)	0 (0)	6,816 (98.1%)	0 (0)	3 ( )	130 (1.9%)
1965	2,965 (28.9%)	3,373 (32.9%)	3,717 (32.6%)	204 (2.0%)	5,771 (77.8%)	168 (2.3%)	0 (0)	1,481 (20.0%)
1960	10,112 (64.1%)	5,107 (32.4%)	0 (0)	547 (3.5%)	3,682 (51.7%)	599 (18.4%)	0 (0)	2,129 (29.9%)
1955	4,768 (44.4%)	2,102 (18.7%)	0 (0)	3,965 (56.9%)	12 (0.2%)	599 (12.9%)	0 (0)	4,032 (86.8%)

a. Less than 0.1%.

availability of commercial size male crabs, with a maximum occurring during the summer months in South Carolina (Fig. 7-5). The large crab catches in October of 1973 and 1975 might be attributed to strong recruitment of crabs hatched in that year (Eldridge and Waltz 1977). With the decline in crab trawling effort, seasonal crab catches in Georgia have displayed a similar pattern to that of South Carolina (Fig. 7-5).

d. Fishery Trends. Since the 1920's, blue crab landings in South Carolina and Georgia have generally increased, with the most significant increases occurring after World War II. This was probably associated with increased demands for blue crab meat and fresh blue crabs. Since 1955, there have been significant fluctuations in blue crab landings in both States (Table 7-1). These fluctuations have been influenced by fishing effort, environmental factors, and economic conditions.

Between 1959 and 1963, crab landings in the two States reached an all time high (Table 7-1). A combination of factors, including favorable environmental conditions resulting in large crab year-classes, increased use of more efficient fishing methods (Fig. 7-6), and economics were largely responsible for the increased catches during these years. From 1965 through 1968, blue crab landings declined significantly (Table 7-1). In 1966, record Chesapeake Bay landings apparently depressed crab prices in South Carolina and Georgia, which may have influenced crab fishing effort to some degree. Also during the 1966 - 1968 period, crab mortalities associated with the "gray crab disease" (McKenzie 1970) were reported along the South Atlantic coast. By 1968, crab landings reached their lowest level since 1950 (Fig. 7-6). Processing plants began to reduce production and in 1968 two plants in South Carolina closed.

With the decline in blue crab supply, ex-vessel prices began to reflect an increasing demand by 1969. Landings began to increase during 1969 and 1970, reaching normal levels in the early 1970's. Although a decline in landings occurred in 1976, crab landings increased in 1977 and again in 1978. A total of approximately 20.2 million lb (9.2 million kg) of blue crabs (9.4 million lb or 4.3 million kg in South Carolina and 10.8 million lb or 4.9 million kg in Georgia) were reported harvested in 1978 (U.S. Department of Commerce, NOAA 1980). These landings were the highest combined total for both States since the peak production period which occurred during 1959 - 1963.

e. Market Channels. The blue crab market channels are less complex than those of the shrimp market. The largest quantities of crabs are purchased for processing or shipping directly to northern markets. The largest blue crab processing operation in the United States is located at Port Royal, South Carolina. This canning operation utilizes a significant portion of the South Carolina catch. In the early summer months, however, crabbers are often able to sell the larger crabs directly to out-of-State buyers rather than local processors. The extent to which these sales occur is largely determined by the price differential between the local processor and out-of-State buyers (Rhodes 1974b).

The crab meat canned in South Carolina moves into national distribution channels under a brand name and is commonly found in supermarkets and gourmet shops throughout the country. Crab meat processed by smaller plants is sold primarily to northern markets or regional institutional channels (e.g., supermarkets). Institutional dealers supplying processed "deviled" crabs to South Carolina retail and restaurant outlets use only limited quantities of South Carolina crab. The bulk of these dealers' supply constitutes machine-picked crab from Virginia because the Virginia crab is cheaper and the supply more reliable than the higher quality South Carolina handpicked product (Laurent et al. 1975).

The crab marketing system in South Carolina and Georgia allows crabbers greater flexibility than shrimpers to sell to alternative buyers when prices are favorable for doing so. This flexibility results because crabs sold fresh require few facilities (usually only an assembly point is required). Crabbers can often sell their large crabs ("Jimmies") to Maryland and Virginia buyers, and sell the rest of their catch to Georgia and South Carolina processors.

f. Fishery Cost-Price Relationships. As is the case with shrimp, consumer demand for blue crabs has been very responsive to rising income levels (Wheeland 1973) and consumption per capita has been steadily rising. Commercial crabbers can expect greater demand for crabs in the short-run (Strand 1977). In the processing sector, increased productivity has been partially facilitated by labor-saving devices.

The lowest ex-vessel prices are generally paid during the summer months and in the early fall. During the 1960's, Georgia's prices were mainly dominated by the only four crab meat processors in Georgia (Carley and Frisbie 1968); consequently, fishing effort was partly limited by processing capacity and inventory accumulation. As previously discussed, recent changes in the market, due to direct shipping to Virginia and Maryland, have probably improved the relative summer price trends for the commercial crabber in both States.

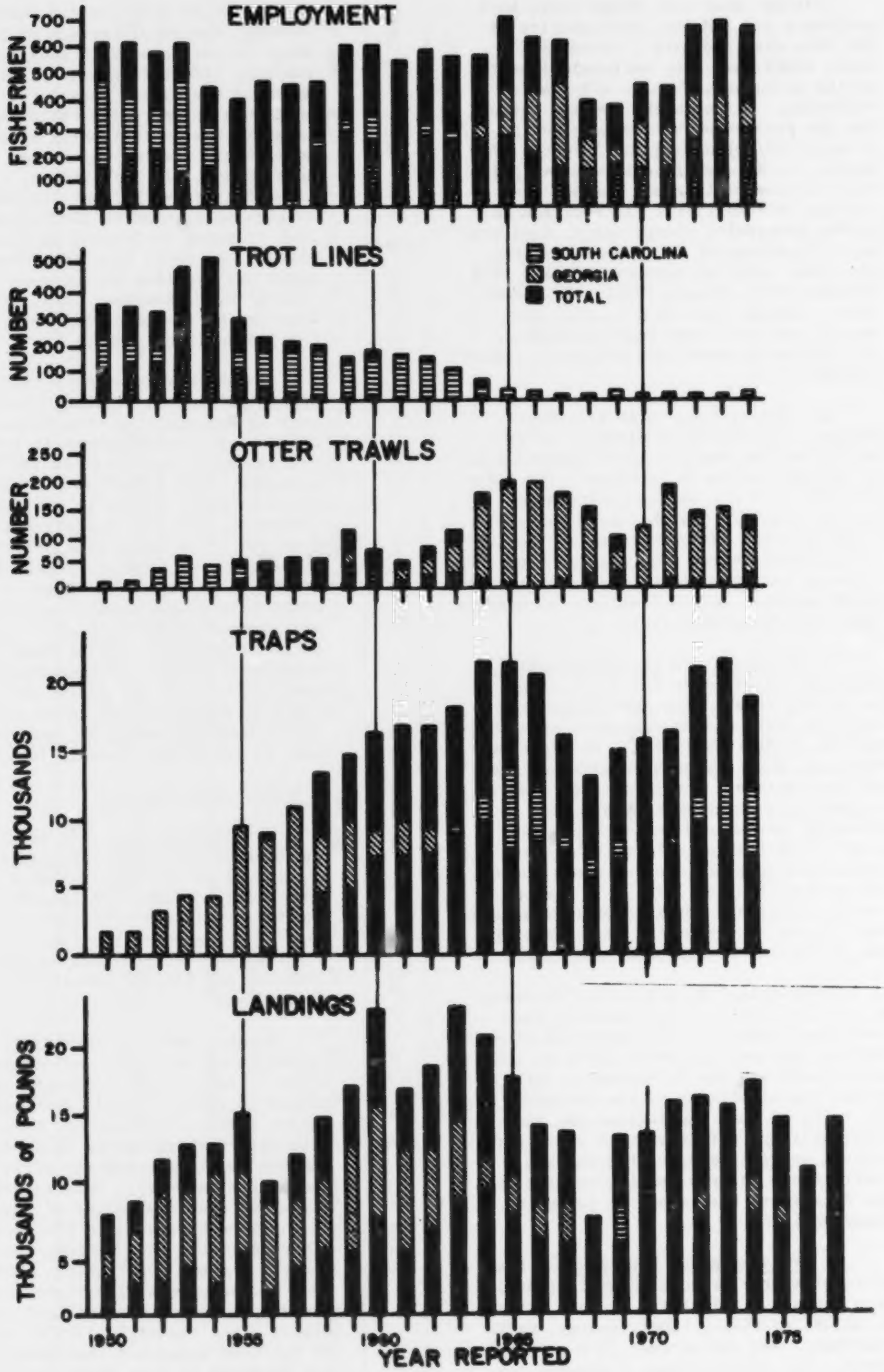

Figure 7-6. Blue crab employment, fishing gear, and landings for South Carolina and Georgia, 1950 - 1977 (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

Rising labor and energy costs have seriously reduced the profitability of the blue crab industry (Strand 1977). Labor costs have most seriously impacted on the processor, despite efforts to mechanize. Although the average markup for the processing sector tripled ($0.76/lb to $2.37/lb) during the 1970 to 1977 period, it is questionable whether price elasticities will permit further increases (Strand 1977). In addition to rising processing energy costs, fuel cost as a percentage of total gross returns has almost doubled between 1972 and 1976 (Rhodes 1974b, Folsom 1976). In recent years, rising costs (e.g., labor and energy) may also have been responsible for rising ex-vessel and wholesale prices (Strand 1977).

g. Processing. Crab processors supply a significant employment alternative for the small coastal communities of Georgia and South Carolina. The value added by crab processing contributes substantially to the wholesale value of South Carolina seafood products. In 1975, the wholesale value of processed blue crab products was approximately $3.8 million in South Carolina and $4.0 million in Georgia (Bell and Fitzgibbon 1978).

h. Conservation and Management Policies. State laws and regulations pertaining to the blue crab fishery in South Carolina and Georgia have been summarized by Bearden (1978). As might be expected, both States have similar laws and regulations. The legal environment is generally directed at protecting spawning females and small crabs, and controlling fishing effort through restrictions on gear, fishing areas, catch, and season (Bearden 1978). In some cases, creeks and portions of rivers have been closed to commercial crab trapping due to conflicts with other user groups.

Considering the population dynamics of the blue crab, it has recently been questioned whether the regulations protecting egg-bearing female crabs or subadult crabs are really necessary for future sustainability of the resource. The value of such regulations may rest in their ability to improve crab yield per recruit or, in the case of mesh size restrictions on crab trawls, regulations may facilitate the escape of juveniles (Bearden 1978).

i. Prospects and Potentials. Small-scale blue crab processors will probably face serious difficulties as they attempt to adjust to rising labor, energy, waste treatment, and raw product (i.e., crabs) costs. In certain areas, a seafood industrial park may be the only alternative for meeting these rising costs (McKenzie et al. 1976). Substitute processed products (e.g., snow crab) for blue crab in institutional markets may erode the wholesale price for blue crab meat.

In South Carolina and probably Georgia, the total harvest of blue crabs might be increased with additional crab trapping effort (McKenzie et al. 1976). Assuming the market demand for blue crabs continues to increase, the prospects of large increases in fishing effort do not seem likely due to competition from other user groups. In both States, recreational fishermen and waterfront landowners have sought legislation to further restrict crab trapping activities in creeks and rivers. In South Carolina, these pressures are expected to increase in the future (C. M. Bearden, 1978, South Carolina Marine Resources Division, Charleston, pers. comm.).

A possible area for potential development within the present industry structure is the adoption of soft-shell crab technology. This fishery is a very profitable one in the Virginia and Maryland area and, with proper modifications, could probably evolve to a significant commercial scale in Georgia and South Carolina. The production of soft-shell crabs has been limited largely because of the inability of fishermen to obtain crabs in shedding conditions. It is felt that production of soft-shell crabs has definite possibilities at least as a supplement to the existent fishery. It appears that the demand for soft-shell crabs is strong enough to warrant speculative business ventures, and the resource base is relatively unexploited.

3. The Oyster Fishery

a. The Resource. In South Carolina and Georgia the oyster (*Crassostrea virginica*) is the most valuable of the commercial mollusks and exceeds the production of all other mollusks combined. In 1977, commercial landings in South Carolina and Georgia were valued at $866,725 and $75,000 respectively (Table 7-12).

Perhaps more has been written about oysters than any other marine invertebrate. Clark (1920) indicated that the oyster is scientifically the best known marine animal in the world; however, even with this vast amount of knowledge, serious problems presently exist within the oyster industry. Concern has been expressed over the future of the industry in southern States since the late forties (Chipman 1948); this concern still exists today. Through overfishing, pollution, lack of management, labor problems, etc., oyster production has declined considerably since the early 1900's (Table 7-1). It has been suggested that overharvesting has occurred in both South Carolina and Georgia (Lunz 1935, Mahood and Reisinger 1975). The overharvesting is due to a lack of long-term oyster cultivation practices (shell planting) to sustain commercial yields (Lunz 1968, Mahood and Reisinger 1975).

Table 7-12. Pounds of meat and ex-vessel value (dollars) of oysters harvested for South Atlantic States from 1973 - 1977 (U.S. Department of Commerce, NOAA 1971 - 1980).

State	1973		1974		1975		1976		1977	
	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars	Pounds	Dollars
North Carolina	548,431	$ 446,485	558,821	$ 435,704	424,831	$ 329,794	333,315	$ 292,058	365,714	353,581
South Carolina	878,014	505,362	1,119,021	657,508	1,036,401	616,549	1,187,077	759,063	1,280,962	866,725
Georgia	105,998	65,122	64,664	36,040	44,062	25,062	71,839	49,240	87,221	75,000
Florida - East Coast	122,389	98,505	97,724	85,523	79,417	76,891	111,781	114,267	NOT AVAILABLE	NOT AVAILABLE
TOTALS	1,654,832	$1,115,474	1,840,230	$1,214,675	1,584,711	$1,084,847	1,704,012	$1,214,628	1,733,897	1,295,306

In addition to resource exploitation, natural causes (storm, disease, and predators, etc.) and man-induced alterations of the environment have also contributed to changes in oyster standing crops. Oyster acreage available to commercial harvesting in South Carolina and Georgia has declined due to the closing of certain areas as a result of water pollution (Godwin 1968a,b, Bearden et al. 1976). In South Carolina, other man-induced environmental degradations include altered drainages of coastal wetlands and diversion of coastal waters, resulting in increased siltation and undesirable salinity fluctuations (Gracy et al. 1978).

Several oyster surveys have been conducted during recent years in South Carolina and Georgia (Keith and Cochran 1968, Gracy and Keith 1972, Keith and Gracy 1972, Gracy et al. 1978, Harris 1978). In a recent survey in Georgia, it was estimated that there are approximately 251 acres (101.6 ha) of intertidal oyster beds and 40 acres (16.2 ha) of subtidal oyster beds in that State's coastal area (Harris 1978). This represents a considerable decline from the 1700 acres (688 ha) of oyster beds reported in an 1889 survey by the U.S. Coast and Geodetic Survey (Drake 1891). Although no recent comprehensive survey of South Carolina's oyster resource has been conducted, it is believed that the acreage of both intertidal and subtidal oysters is much larger than in Georgia. For example, there are over 6,000 acres (2,428.2 ha) of intertidal bottom habitats producing oysters or capable of producing oysters which are currently under lease to commercial shellfish firms (Atlas plates 31 - 40).

There are 62 leases in South Carolina, all of which are intertidal. Of these leases, 44 are considered to be commercial leases; the remainder are recreational. While intertidal oysters can be found in almost every saltwater influenced stream in the study area, only a small percentage of oysters in this region occurs below the low tide mark (Keith and Cochran 1968). In South Carolina, approximately 1,400 acres (566.6 ha) of subtidal oyster bottoms exist in the Wando River and Santee Estuary (Gracy et al. 1978). Two other subtidal areas, located in the Ashepoo River and Alligator Creek, contain less than 10 acres (4.1 ha) each. In Georgia, the largest subtidal bed (26.5 acres or 10.7 ha) is in Altamaha Sound. In addition, Jones Creek and the Frederic, Mackay, Hampton, and Davis rivers contain small beds of less than 6 acres (2.4 ha) each (Harris 1978).

Subtidal oysters are generally small and are infrequently utilized as seed source by commercial lease holders. There is presently little direct marketing of subtidal oysters in the study area. Possibly one major exception to this is the limited harvesting in the Santee Estuary ancillary to clam harvesting by hydraulic escalator clam dredges. However, this production never exceeds 2,000 bushels annually.

b. The Industry. The earliest users of seafood in the study area were the indigenous prehistoric Indians. A staple among the various types of seafood utilized was the oyster. Evidence of Indian usage is relatively abundant around many estuarine areas. The presence of a 300-ft (91.5 m) diameter oyster shell ring on Sapelo Island and a 250-ft (76.2 m) diameter shell ring near Fig Island (see Volume I, Chapter Two) as well as numerous other shell rings and middens, document extensive Indian usage (Moore 1897, Edwards 1965, Williams 1967, Hemmings 1970).

Before explorers and colonists landed in North America, oysters were eaten and shells utilized for many years in Europe. Europeans were therefore familiar with oysters upon their arrival in North America, and early accounts show an interest in their local availability (Catesby 1771, Stevenson 1894, Salley 1967). Early settlers relied extensively on oysters for both food and construction material (Harris 1978). Oyster shells were frequently burned in kilns to produce lime for use as a binder or cement for building purposes. A cement-like fabrication containing oyster shells, known commonly as "tabby," was used frequently for construction purposes in Southeastern coastal regions from the colonial period to the Civil War (Coulter 1937). Oyster shells are still used to some extent as a stabilization material in road construction and as a material superior to crushed rock in septic tank tile-field construction (Anderson et al. 1979).

Although there was extensive subsistence usage, a true oyster industry did not develop in the study area until about the last third of the nineteenth century. The first harvesters probably took orders for specific quantities before harvesting was undertaken (Keith and Gracy 1972). Commercial steam oyster canning did not commence in South Carolina until the last quarter of the nineteenth century. Prior to 1892, Oemler Oyster Company in Savannah, Georgia, purchased oysters from a Beaufort producer who used a steam dredge to obtain select oysters in South Carolina. The first commercial raw shucking operation in South Carolina is believed to have begun about 1885 in Beaufort or Jasper County. By 1890, both Bulls Bay and Edisto Fish and Oyster companies had cultivated subtidal oysters in Santee Pass Creek near Capers Island and Bulls Bay (Keith and Gracy 1972). However, many were of inferior quality to the natural intertidal oysters of the area (Dean 1892). Historical efforts to develop and expand subtidal oyster beds using cultivation practices similar to those in the mid-Atlantic States (Bailey and Briggs 1968) have resulted in only marginal success in South Carolina (Gracy and Keith 1972).

Available records indicate that from about 1888 to 1908, oyster landings increased from less than 1 million lb (.45 million kg) to over 7 million lb (3.18 million kg) of meat annually (Table 7-1). This peak in production has never again been equaled. Although approximately 4 million lb (1.81 million kg) of meat production was reported in the late 1920's and again in the mid-1960's, production has generally declined since 1908 (Gracy et al. 1978).

Historically, oyster harvesting for cannery production has constituted a major commercial fishery in the study area. Canning operations use the intertidal oyster despite its clustering tendencies, irregular shell morphology, and low meat yield. Reportedly, 16 steam canneries operated in South Carolina between 1890 and 1905 (Keith and Gracy 1972). In 1919, there were five canneries in the Charleston area and six near Beaufort (Churchill 1920). By 1939, 86% of all oysters harvested in South Carolina were canned, and only 14% were raw shucked or sold in the shell (Lunz et al. 1944). Production decreased during World War I (1917 - 1918) to slightly more than two million bushels. Production increased between 1926 and 1933 and was probably due to a decrease in labor costs (Lunz 1950). It declined again during World War II (1939 - 1945), presumably again due to competition from war-related employment (Gracy et al. 1978).

Despite the adoption of mechanized shucking and floating methods by steam canneries in the mid-1950's (Lunz 1960), processing and harvesting costs have reduced oyster processing in South Carolina to one cannery, with an accompanying decline in oyster landings (Table 7-1). In addition, the lack of cultivation may have been partially responsible for the gradual decline in oyster landings (Lunz 1950, 1960). It has also been suggested that the decline was a symptom of oyster bed depletion through overharvesting by canneries (Lunz 1950, Mahood and Reisinger 1975). Other possible reasons for this decline include physical deterioration of the environment due to: 1) drainage of coastal wetlands which may have increased siltation and promoted rapid fluctuation of salinities, both of which promote oyster mortality; 2) destruction of subtidal beds due to radical salinity changes resulting from the construction of the Atlantic Intracoastal Waterway; and 3) closing of productive bottoms due to fecal coliform pollution. Continued loss of skilled harvesting labor to alternate employment and lack of practical harvesting mechanization have further reduced production capacity (Gracy et al. 1978).

Development of the Georgia oyster industry parallels that of South Carolina. During the late 1800's, oyster canneries developed in several locations along the Georgia coast. Canneries were operated during the twentieth century in Thunderbolt, Brunswick, and Cedar Point by the Maggioni family; at Harris Neck by the Oemlers; and in Darien by the Ploegers. Two canneries operating in Glynn County produced 30,000 cases of canned oysters in 1902 (Harris 1978).

During the latter part of the nineteenth century and early in the twentieth century, Georgia's oyster fishery experienced wide fluctuations in landings. Complete annual records are not available prior to about 1950; however, increases and declines representing over 1 million lb (.45 million kg) of oyster meat occurred during 2 to 5 year time spans. The most drastic decline (from about 8 million lb (3.63 million kg) to about 3 million lb (1.36 million kg) occurred between 1908 and 1918 (Table 7-1). This was very similar to South Carolina experiences during the same period. Since 1936, Georgia's annual landings have gradually declined from a high of 330,000 lb (149,685 kg) to a low of 38,000 lb (17,236 kg) in 1978. These figures, and contact with persons familar with the industry during this period, make the accuracy of the earlier figures somewhat suspect. Landings throughout the region were high during the early 1900's, suggesting that perhaps overharvesting created a pronounced decline in Georgia's oyster production (Harris 1978).

The current status of the Georgia and South Carolina fisheries is similar, although both the standing oyster crop and value harvested are much less in Georgia. In recent years, South Carolina's oyster production exceeded that of the other three South Atlantic States (Table 7-12). These oysters were harvested predominantly in the intertidal zone by hand labor.

Harvesting techniques have changed little since the nineteenth century. With the exception of the "factory" as a major buyer, Lunz's 1944 description of harvesting is probably still basically accurate for the entire study area, although much reduced in scope (Lunz et al. 1944).

> ". . . a power launch tows 15 to 20 flat bottom barges 16 to 18 feet long from the factory to the oyster grounds. The oyster pickers then spread out over the beds picking by hand or with grabs from ebb tide through low water and until tide becomes too high for further gathering. The oysters are unculled

> and are loaded into the "butt-head" (sic) bateaus, just as they come off the banks. When the boats are filled to capacity, they are again towed to the factory or occasionally unloaded on the spot into large lighters which are towed to the factory."

The decline in oyster harvesting effort in recent years, due to increased labor costs and other economic factors, has apparently forced producers to curtail shell or seed planting activities. Compared to lease management efforts of the Chesapeake Bay area, most leaseholders in South Carolina and Georgia do not intensively cultivate or thoroughly supervise harvesting. (See Atlas plate 44 for a comparison of oyster production by area within each State.)

The study area's present oyster production can be classified into three major intertidal oyster marketing or processing categories: 1) steam canning; 2) raw shucking; and 3) shell stock oysters.

Steam canneries no longer operate in Georgia. The Ploeger facility was the last cannery to operate in this State, closing in 1960 (Harris 1978). Termination of canning operations has undoubtedly been a prime factor in declining production. One steam cannery remains in operation in South Carolina. This oyster canning operation (Ocean, Lake, and River Fish Company) on Lady Island accounts for approximately 50% of the State's commercial oyster production. This operation is characterized by a high degree of vertical integration from harvesting to wholesale inventory control. Shell obtained from canning operations is planted by using high-pressure water hoses to wash the shell overboard from towed lighters onto leased bottoms. Intertidal oysters are bought from harvesters working either on the company's leases or other leases. It is not uncommon for oyster fishermen to cull the larger intertidal oysters for retail sale, especially in the Beaufort area (Gracy et al. 1978).

Raw shucked and shell stock oysters are marketed either as raw shucked oysters in containers or as oysters in the shell. The seafood firms engaged in these operations are generally characterized by horizontal integration, especially the wholesaling of shrimp. It is not uncommon for laborers employed in raw shucking to be used in shrimp packing operations. These shucking enterprises will sell oysters in individual containers to retail stores and directly to consumers (Rhodes 1974a). Shell stock is usually sold in U.S. bushel measurements to both dealers and individuals. A bushel of shell stock oysters is sold in two grades: clusters or singles. Cluster oysters are smaller than singles and usually have a lower meat yield. Larger oysters are usually culled from the cluster and sold as single oysters. Ultimate use of shell stock is probably confined almost entirely to in-shell oyster roasting or raw oysters served on the half-shell.

Producers involved in the raw shucked and shell stock operations generally have access to small self-propelled boats or equipment from other fisheries, such as shrimp trawlers, to assist in planting operations on their leases. Often the raw shucked/shell stock oyster businesses are family owned and have been involved in commercial fishing for a long period of time.

Fishermen involved in the shell stock category of commercial harvesting and marketing may or may not have docking facilities. In some cases, they may be independent commercial fishermen who will periodically work for different leaseholders during the oyster and clam season. In Georgia, this has become a major form of harvesting and these independent harvesters generally do little processing and may take special orders for private parties and retail stores (Mahood and Reisinger 1975). In some cases, they may also be involved in illegal harvesting and raw shucking operations.

A specialty category of operations has developed in the Murrells Inlet area, which provides oysters for half-shell market. These oysters are harvested from leases within the Murrells Inlet area and sold in the restaurants owned or controlled by the leaseholder (Gracy et al. 1978).

In 1978, only nine operators were licensed to harvest oysters in Georgia, although each may have several pickers working for him. Only one licensed operator currently shucks oysters. The remaining operators sell their harvest as shell stock. All harvesting currently takes place in the intertidal zone near low tide and is done by hand.

In 1975, the last year for which reliable figures are available, there were 23 major oyster producers in South Carolina with a total labor force of about 384 persons directly engaged in oyster harvesting and processing (Gracy et al. 1978). Currently there are probably slightly more than 300 in this category; however, the exact number is not presently documented. As in Georgia, most harvesting takes place in the intertidal zone by hand.

The present distribution of intertidal oysters in both Georgia and South Carolina is similar to the distribution of the resource at about the beginning of this century (Drake 1891, Dean 1892). The extent of live oyster acreage, however, is reduced, especially in Georgia. It appears that oyster resources have declined concurrent with the decline in oyster landings. The reasons for the decline of intertidal oyster resources are not entirely clear. Perhaps it results in part from poor management, including inadequate law enforcement. Laws, especially those which require the harvester to return a portion of the shells harvested to the growing area, have been in the Georgia Code since at least 1889 (Drake 1891). In South Carolina, shell planting laws have existed since World War I (Keith and Gracy 1972). Georgia's oyster laws are apparently difficult to enforce. Failure to replace shell material to harvested areas is probably the most significant reason for the depletion of Georgia's oyster resources. This shortcoming rests not only with the resource managers and enforcers, but with the resource users. Oystering is a farming operation, requiring proper cultivation, especially the planting of cultch or seed (Harris 1978).

The South Carolina shellfish bottom leasing system provides greater exclusive user control of the bottoms than does the Georgia system. It also provides for an annual shell/seed oyster planting requirement which is enforceable by lease cancellation for non-compliance. All planting must be verified either by management or law enforcement personnel of the South Carolina Wildlife and Marine Resources Department. Only intertidal bottoms are leased. No subtidal bottoms containing oysters are leased. The current preference is to have subtidal oysters available as a common seed source for planting purposes (Gracy et al. 1978).

Although various parasites and diseases have been identified, it is not known to what degree they have caused depletion of the intertidal oyster crop (Harris 1978). Nowhere in the study area are parasites or diseases presently considered a serious threat to productivity.

Other factors, while not causing depletion of the resource, have been detrimental to the industry. Pollution and the lack of an adequate shellfish sanitation program are major factors, as they have resulted in the closing of about 75% of Georgia's oyster growing waters (Kumpf 1977). In South Carolina, about 28% of the waters are closed to shellfishing (Bearden et al. 1976). In Georgia, laws which grant riparian rights to harvest, particularly in the intertidal zone, have created additional problems related to leasing shellfish growing areas (Carley and Frisbie 1968). Adjacent waterfront property owners are also provided leasing rights in South Carolina, however, only for non-commercial use. Acreage is limited to 4 acres (1.6 ha) or less and must not extend past projected waterfront property boundaries. Planting requirements identical to commercial leases must be met annually.

The oysterman's inability to hire and retain labor in a seasonal industry is probably the industry's primary problem in South Carolina. Many commercial producers feel that production would increase rapidly if additional labor was available or if an efficient mechanical harvester was perfected to safely harvest intertidal oysters (G. J. Maggioni, 1979, Ocean River and Lake Co., Beaufort, pers. comm.).

c. The Industry's Future. The oyster industry at one time produced in excess of 6 million lb (2.7 million kg) of meat a year in both South Carolina and Georgia (Table 7-1). Although there has been a decline in production for many years, a concentrated effort by industry and management may be able to arrest, if not reverse, this trend.

Riparian rights are a limiting factor in Georgia's production. Exclusive rights to adequate growing areas are necessary to ensure that the industry has sufficient control of its assets. Unless this can be done, investments in the industry will remain minimal. South Carolina, with its present leasing system, appears to have provided adequate investor control of oyster bottoms.

In both States, the industry, especially in harvesting, remains labor intensive. While conventional "box" oyster dredges have been traditionally used for harvesting subtidal oysters in other States, the use of any mechanical device in harvesting intertidal oysters has been limited by: 1) legal restrictions due to potential ecological damage; 2) physical accessibility to intertidal grounds; and 3) experimental investment costs within a declining industry.

Until a safe intertidal mechanical harvesting device is developed, production will remain static under present socioeconomic conditions. Continued use of older labor-intensive technology, especially in harvesting, hampers the industry's attempts to increase production at all levels.

In addition to mechanical harvesting techniques and methodology, consideration should be given to marketing alternatives. Additional marketing categories such as frozen breaded oysters might be developed. Institution buyers provide a potentially large outlet. Frozen oyster products increase handling efficiencies and advertising potential, which appeal to large retailers (Gracy et al. 1978).

Pollution is a very real problem. Considering the number of acres closed due to pollution and the problems associated with pollution abatement, management should encourage the utilization of oysters from these areas as a seed source. South Carolina in particular has polluted areas overgrown with oysters which would be suitable for transplanting to clean water for purification (McKenzie and Badger 1969).

The problems involved in oyster production are numerous and complex. Although a significant decline in the actual quantity of oysters has occurred, the resource base appears to have a potential for expansion. If the complex problems of labor availability, management, pollution, and marketing can be resolved, the oyster industry can occupy a position of greater economic importance in the fisheries of South Carolina and Georgia in the future.

4. The Clam Fishery

a. The Resource. Hard clams (*Mercenaria mercenaria*) are normally found throughout South Carolina and Georgia in small intertidal creeks and protected areas not exposed to wave action or strong currents. With the exception of the Santee River estuary, South Carolina, commercial densities of clams are scarce in open estuarine areas. Furthermore, hard clams in the South Carolina-Georgia region are often found in conjunction with oyster populations and in areas that are protected by overlying shell substrate (Anderson et al. 1978). The clam fishery in South Carolina has always been limited compared to industries of the middle Atlantic and Chesapeake Bay States. Georgia's production is almost negligible (Table 7-1). (See Atlas plate 44 for a comparison of clam production by area within South Carolina and Georgia.)

The earliest record of commercial clam production in South Carolina was in 1900, when 1,120 bags of clams were shipped by steamer from Charleston to New York. State fisheries statistics for the period 1924 - 1947 indicate that the State's hard clam production did not exceed 5,000 bushels each year. Prior to 1940, the majority of clams harvested each year in South Carolina were consumed locally (Lunz 1944), and the existing clam industry was located in Georgetown County. Reasons for low clam harvests were the lack of demand and small profit for shellfishermen at current market prices. In 1940, clams were sold for slightly less than 30 cents per bushel (Bearden et al. 1976).

Since 1960, hard clam production in South Carolina has fluctuated considerably, ranging from a low of 1,162 bushels in 1968 to a high of 23,429 bushels in 1978. The clam fishery in South Carolina has recently been stimulated by three factors: 1) a comprehensive statewide resource survey resulting in the discovery of commercial density subtidal beds in the Santee River estuary, 2) mechanization of harvesting methods, and 3) increases in hard clam prices.

A comprehensive hard clam resource survey in South Carolina (Anderson et al. 1978), using hydraulic patent tongs, located 6,809 acres (2,756 ha) of clam bottoms. During the 4-year survey (1973 - 1977), 35,922 yd^2 (30,174 m^2) of bottom samples were taken throughout the State's estuaries to assess clam densities and bottom types. Sixty-eight percent of the total clams sampled, and highest clam densities, were found coincident with a mixture of sand and shell substrate. Initial survey results during the fall of 1973 and early 1974 resulted in the discovery of high density subtidal clam populations in the Santee River estuary.

The early clam industry in Georgia was described by Prytherch (1964) as somewhat viable from 1880 until 1932. Peak production of 43,000 lb (19,504 kg) occurred in 1908 (Table 7-1). Catches declined substantially since that period and Georgia shellfishermen have reported that clams are taken only incidental to oyster harvesting (Godwin 1968a).

A 2-year resource survey of 432 areas in Georgia (Godwin 1968a) located *Mercenaria mercenaria* in 41 areas, or less than 10% of the samples. Highest clam densities were found in a mixture of sand, mud, and shell. The majority of Georgia's clam populations were located in intertidal areas where water depth was less than 10 ft (3 m). Godwin (1968a) concluded from the survey results that little potential existed for a commercial hard clam fishery on the Georgia coast. Most clams observed during the survey were inaccessible to large commercial fishing gear and densities were too low for commercial exploitation. Furthermore, marketing continues to be a problem for the small hand-gathering industry.

b. Species Composition. *Mercenaria mercenaria* is the most abundant of the hard clams found in Georgia and South Carolina. However, the southern clam, *Mercenaria campechiensis*, is sympatrically distributed in considerably smaller numbers in the estuaries of both States and in higher salinity waters offshore. Eldridge et al. (1976a) estimated relative abundance of *Mercenaria mercenaria notata* from 11 South Carolina locations to be 1.23% of the population sampled. The reciprocal hybrids of *M. mercenaria* and *M. campechiensis* are also found in small numbers throughout South Carolina's coastal waters (Anderson et al. 1978). A survey by Godwin (1968b) in the Altamaha River, Georgia, indicated commercial potential for the brackish water clam *Rangia cuneata*. However, domestic fecal coliform pollution apparently inhibits development of the fishery in the low salinity environment. (See Atlas plates 31 - 40 for open shellfish areas.)

c. Fishing Methods. Prior to 1974, hard clams in Georgia and South Carolina were harvested by a variety of hand gathering techniques. Equipment such as oyster tongs, clam rakes, and bull rakes have been utilized for successful commercial harvesting. Hydraulic harvesters were introduced into the Santee estuary in 1974, and the fishery has continued to the present time. The harvester (described by Manning 1957, MacPhail 1961, Mathieson and DeRocher 1974) consists of several water jets that loosen the substrate in front of a scoop (escalator head). Hard clams and substrate are flushed onto a conveyor belt and carried to the surface for hand sorting (Rhodes et al. 1977b). Seven permits are issued annually and harvesting is managed by the South Carolina Marine Resources Division. Harvesting is restricted to 2 days per week and the hydraulic escalator fishery normally operates from January to April, depending on ex-vessel clam prices. Since the 1974-75 clam season, South Carolina's hard clam ex-vessel revenue has exceeded the presurvey annual average production level by six times (Anderson et al. 1979) (Table 7-13). It is anticipated that a continuing fishery can be maintained in the Santee estuary by limiting fishing effort and rotating harvest areas to allow for natural recruitment. However, the proposed rediversion of freshwater discharge from the Cooper River into the Santee River by the U.S. Army Corps of Engineers is anticipated to have a detrimental impact upon the currently viable industry (U.S. Army Corps of Engineers 1975a).

Hand tonging and raking in the intertidal areas continue to be the predominant fishing methods in both States, and these techniques account for much of the production (Table 7-13).

d. Seasons. In South Carolina and Georgia, the clam seasons normally open on 1 September and continue until 31 May of the following year.

e. Processing. Practically all clams harvested commercially in South Carolina and Georgia are shipped as shell stock to out-of-State markets. Clams are either stored dry or refrigerated for short periods prior to shipment.

f. Pollution. In South Carolina, approximately 275,000 acres (111,291 ha) (28%) of the coastal estuarine areas classified as shellfish growing waters are closed due to fecal coliform pollution (Bearden et al. 1976). It is estimated that 75% of Georgia's shellfish growing areas are closed to harvesting because of water quality problems. Fecal coliforms persist at sub-contamination levels in most commercial clam areas (Bearden et al. 1976).

g. Potentials. The mariculture of hard clams is a proven technique (Loosanoff and Davis 1963, Castagna and Kraeuter 1977) that offers exceptional commercial potential in South Carolina and Georgia. Eldridge et al. (1976b) and current research at the South Carolina Marine Resources Research Institute indicate excellent grow-out rates for Mercenaria mercenaria seed at several locations in South Carolina estuaries. The longer growing season and year-round clam mariculture potential of Georgia and South Carolina enhances the prospects for future commercial hard clam mariculture production.

Revitalization of natural growing areas and transplanting from polluted areas for purification using a hydraulic escalator harvester has potential for increasing production in certain coastal areas of the two States. Legislation pertinent to clam harvesting and mariculture is needed to encourage future development of the industry. Existing statutes in South Carolina pertaining to leasing for shellfish culture apply entirely to oysters, with no provision for leasing bottoms for clam culture. State law also provides for a closed season for harvesting clams between 1 June and 1 September of each year. Several shellfish industry members in South Carolina feel that this restriction prevents them from establishing year-round markets (Bearden et al. 1976).

5. Commercial Finfish Fisheries

Unless otherwise noted, data presented in this section were obtained from the Annual Summary series of fishery statistics of the United States, prepared by the National Marine Fisheries Service (U.S. Department of Commerce, NOAA 1971 - 1980).

South Carolina and Georgia rank third and fourth respectively in commercial fishery landings among the four South Atlantic States. Finfish comprise a relatively small component of their total seafood production. Table 7-14 presents finfish and shellfish landings and values for 1970 - 1976. North Carolina landings are shown to provide an index of the relative magnitude of finfish landings in South Carolina and Georgia.

South Carolina commercial fishery landings averaged 20.5 million lb (9.3 million kg) annually valued at $9.4 million during 1970 - 1976, of which only 20.2% of the weight and 6.8% of the value were made by finfish. Finfish landings accounted for a considerably smaller proportion of Georgia's total commercial landings, comprising 5.3% of the poundage and 3.1% of the value. Average annual finfish production during 1970 - 1976 was 4.2 million lb (1.9 million kg) and

Table 7-13. South Carolina hard clam landings in bags (250 ungraded clams per bag) from the 1971-72 clam season through the 1976-77 season (Anderson et al. 1978). (In South Carolina, the clam season is from 1 September until 1 June of the following year.)

	HARVEST METHOD					
	NON-MECHANICAL		HYDRAULIC ESCALATOR			
Clam Season	Quantity	Percent[a]	Quantity	Percent[a]	Total	Total Ex-vessel Value
1971-72	5,296	100%	0	0%	5,296	$ 17,370
1972-73	11,292	100%	0	0%	11,292	44,273
1973-74	4,594	64%	2,582	36%	7,176	45,339
1974-75	11,302	27%	30,917	73%	42,220	213,382
1975-76	2,480	9%	25,805	91%	28,288	353,600
1976-77	7,767	39%	12,104	61%	19,877	348,462

a. Percent of total clam harvest for the clam season.

890,000 lb (403,695 kg) in South Carolina and Georgia, respectively (Table 7-14). During this same period, annual North Carolina finfish landings averaged 108,183,000 lb (49,070,727 kg), worth $5,404,000 (Table 7-14).

The lack of effort data associated with the landing figures necessitates the use of caution in making species abundance interpretations from available catch statistics. Additionally, finfish are particularly subject to under-reporting because they are often sold outside of the normal marketing channels used for gathering statistical information. Finfish landings presented in this section are probably underestimates of actual production, but hopefully they are indicative of trends within the fishery.

Twelve species accounted for the majority of South Carolina finfish landings (1960 - 1977), of which five were estuarine or coastal marine species, three were anadromous species, three were offshore demersal species or species groups, and one was a freshwater species (Table 7-15). Eight species comprised the majority of finfish landings in Georgia during the same period (Table 7-16).

South Carolina landings of major species averaged 6.6 million lb/yr (3.0 million kg/yr) during 1960 - 1964 and increased to 8.0 million lb/yr (3.6 million kg/yr) in 1965 - 1969. In the 1970 - 1974 period, annual landings declined to 3.6 million lb (1.6 million kg) and remained at approximately the same level during 1975 - 1977 (Table 7-15). Annual Georgia landings have consistently remained below 1 million lb (0.5 million kg) during each 5-year period (Table 7-16). Approximately 47% of the total Georgia finfish landings during 1960 - 1977 was shad.

a. Estuarine and Coastal Marine Commercial Fisheries. This section deals with commercially important finfish species occurring in the marine and estuarine habitats. (See Chapters Two and Four, Volume III, for biological treatment of the species.) Landings, special features of the fishery, and potentials for expansion are discussed for inshore and offshore groups of commercial finfish. Commercial anadromous and catadromous species are also discussed in this section.

(1) Kingfish. Three species of kingfish are taken commercially in the characterization area: southern kingfish, northern kingfish, and gulf kingfish, with southern kingfish the most abundant. These species prefer inshore coastal waters during the warmer months, moving offshore into 6 - 30 fathoms (11 - 55 m) when inshore water temperatures fall below 10°C (50°F) (Bearden 1963).

Table 7-14. Commercial fisheries landings (1,000 lb) for North Carolina, South Carolina, and Georgia, 1970 - 1976 (U.S. Department of Commerce, NOAA 1971 - 1980).

	NORTH CAROLINA				SOUTH CAROLINA				GEORGIA			
	Finfish		Shellfish[a]		Finfish		Shellfish[a]		Finfish		Shellfish[a]	
Year	lb	value	lb	value	lb	value	lb	value	lb	value	lb	value
1970	143,228	$ 4,561	28,465	$4,795	3,192	$ 388	12,873	$ 3,880	1,067	$223	13,347	$ 3,941
1971	117,150	4,368	24,239	6,847	4,773	536	19,380	7,615	973	260	17,437	7,219
1972	146,847	5,761	21,055	6,038	5,216	718	16,840	7,107	1,075	279	16,469	6,527
1973	111,867	8,516	18,586	7,439	3,886	663	17,187	10,603	841	241	16,344	10,382
1974	173,240	10,347	22,809	6,978	2,770	490	16,225	6,627	728	246	17,246	6,849
1975	32,816	2,226	532	183	3,594	630	16,485	12,488	750	279	16,999	11,699
1976	32,139	2,050	315	188	5,714	1,079	15,765	12,990	800	343	13,727	12,032
1970-1976 AVERAGE CATCH	108,183	$ 5,404	16,571	$4,638	4,163	$ 643	16,393	$ 8,758	890	$267	15,938	$8,374

a. Heads-on shrimp, crabs, shucked oysters, and shucked clams.

Table 7-15. Commercial landings for major finfish species in South Carolina, 1960 - 1977 (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

	ANNUAL AVERAGES FOR PERIODS SHOWN									
	1960 - 1964		1964 - 1969		1970 - 1974		1975 - 1977		1960 - 1977	
Species	000 lb	Rank	000 lb	Rank	000 lb	Rank	000 lb	Rank	000 lb	Rank
Blueback herring	--	—	2,635	(1)	327	(5)	136	(5)	845	(3)
Catfishes	551	(3)	1,100	(4)	671	(2)	402	(3)	712	(4)
Flounders	91	(7)	38	(9)	50	(8)	50	(10)	58	(8)
Groupers	3	(11)	25	(10)	37	(10)	180	(4)	49	(10)
Mullets	2,141	(2)	1,910	(2)	628	(3)	1,768	(1)	1,594	(2)
Black sea bass	224	(5)	242	(5)	451	(4)	84	(8)	269	(5)
Shads	114	(6)	143	(7)	91	(7)	58	(9)	106	(7)
Snappers	36	(10)	14	(12)	20	(11)	102	(6)	36	(11)
Spot	3,042	(1)	1,605	(3)	1,147	(1)	933	(2)	1,765	(1)
Sturgeons	50	(8)	42	(8)	49	(9)	90	(7)	54	(9)
Spotted seatrout	49	(9)	16	(11)	13	(12)	8	(11)	23	(12)
Kingfishes	273	(4)	198	(6)	145	(6)	58	(9)	181	(6)
TOTAL	6,574		7,968		3,629		3,869		7,692	

Table 7-16. Commercial landings for major finfish species in Georgia, 1960 - 1977 (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

	ANNUAL AVERAGES FOR PERIODS SHOWN									
	1960 - 1964		1965 - 1969		1970 - 1974		1975 - 1977		1960 - 1977	
Species	000 lb	Rank	000 lb	Rank	000 lb	Rank	000 lb	Rank	000 lb	Rank
Catfishes	115	(3)	81	(3)	100	(3)	90	(4)	97	(3)
Flounders	30	(4)	32	(4)	60	(4)	95	(3)	50	(4)
Groupers	1	(7)	24	(5)	46	(5)	54	(6)	32	(5)
Black sea bass	1	(7)	6	(7)	35	(7)	14	(8)	15	(7)
Shads	422	(1)	457	(1)	339	(1)	131	(2)	360	(1)
Snappers	3	(5)	18	(6)	37	(6)	58	(5)	26	(6)
Spotted seatrout	2	(6)	5	(8)	19	(8)	26	(7)	11	(8)
Kingfishes	182	(2)	164	(2)	146	(2)	204	(1)	181	(2)
TOTAL	756		787		782		672		772	

In the study area, southern kingfish are caught primarily in shrimp otter trawls from September through December (Keiser 1976). Because kingfish are taken almost exclusively as part of the incidental catch of the shrimp fishery, commercial landings are limited to the open season for shrimp in both States.

Commercial landings of southern kingfish for South Carolina and Georgia (1960 - 1977) are shown in Figure 7-7. Kingfish landings from 1960 - 1977 averaged 181,000 lb (82,110 kg) annually in both South Carolina and Georgia. During this period, South Carolina annual landings ranged from 360,000 lb (163,292 kg) in 1961 to a low of 20,000 lb (9,072 kg) in 1977, with the fishery exhibiting a generally declining trend. Georgia landings ranged from 282,000 lb (127,912 kg) in 1960 to 91,000 lb (41,277 kg) in 1964. South Carolina kingfish landings ranked sixth among finfishes during 1963 - 1977, dropping to ninth place in 1975 - 1977 (Table 7-15). Kingfish landings in Georgia ranked second during 1963 - 1977; most recently (1975 - 1977), they rank first in total weight for a finfish species (Table 7-16). The annual value of kingfish catches in South Carolina and Georgia during 1963 - 1978 averaged $21,400 and $26,600, respectively (Tables 7-17 and 7-18).

Kingfish are primarily marketed fresh in local markets. Apparently, a large percentage of the kingfish taken by shrimp trawlers are discarded because they are not large enough to be marketed. Although there is no legal minimum size, minimum acceptable commercial size is approximately 8 in (23 cm), whereas the average size of kingfish in shrimp trawl catches examined by Keiser (1976) was approximately 6 in (15.5 cm).

(2) Spot. The principal fishery for spot is located in Horry County, South Carolina. Smaller amounts of spot are landed in gill nets in South Carolina and by shrimp trawlers in both States. The majority of spot are taken by haul seines during September through November as the fish make their spawning migration. According to Dawson (1958), shrimp trawler catches accounted for only 5% of the South Carolina commercial catch. Gill nets account for a small but unknown percentage of the catch in South Carolina and Georgia.

Commercial landings of spot in South Carolina are shown in Figure 7-7. Spot landings in Georgia are relatively insignificant, apparently due to regulations outlawing gill net and haul seine fisheries. Spot is one of the most important commercial finfish species in South Carolina, ranking no lower than third in annual total finfish production during 1960 - 1977 (Table 7-15). Average landings of spot ranged from 3.0 million lb (1.4 million kg) in 1960 - 1964 to 0.9 million lb (0.4 million kg) in 1975 - 1977, exhibiting a generally decreasing

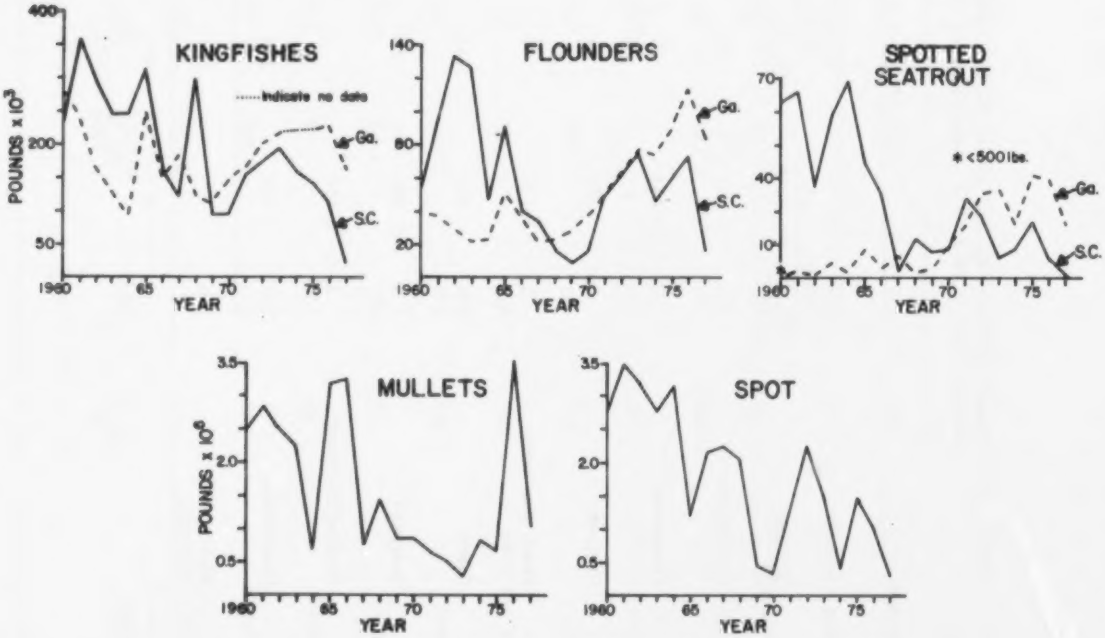

Figure 7-7. Commercial landings of kingfishes, flounders, spotted seatrout, mullets, and spot in South Carolina and Georgia, 1960 - 1977 (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

Table 7-17. Value (dollars) of major South Carolina finfish species, 1963 - 1978 (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

YEAR	BLUEBACK HERRING	CATFISHES	FLOUNDERS	GROUPERS	MULLETS	BLACK SEA BASS	SHADS	STURGEONS	SPOTTED SEATROUT	SOUTHERN KINGFISH	TOTAL FINFISH[a]
1963	-	28,193	29,564	-	165,696	39,580	33,090	8,120	11,392	32,087	3,235,870
1964	-	211,703	11,481	24	47,704	31,352	27,493	9,635	20,657	68,672	3,000,594
1965	55,200	160,446	22,688	4,894	444,909	10,587	61,469	7,680	11,506	31,944	4,927,780
1966	56,340	167,994	10,152	6	193,661	16,669	34,454	7,636	8,585	17,948	4,199,260
1967	56,040	110,938	7,819	-	58,980	8,434	21,025	5,784	597	10,957	3,219,668
1968	48,350	47,488	3,443	10,321	109,738	31,987	20,829	7,958	3,221	24,516	5,610,076
1969	29,625	117,055	1,069	1,594	77,228	169,330	58,909	1,258	3,055	10,428	5,248,162
1970	1,500	60,115	2,583	1,576	17,180	164,373	38,994	7,416	2,499	10,573	4,267,525
1971	11,600	144,283	8,983	1,632	44,862	131,962	39,934	14,712	6,175	16,591	8,139,357
1972	5,933	143,995	12,353	4,174	23,420	198,625	44,992	18,208	5,535	21,150	7,825,670
1973	12,986	154,168	16,636	29,330	26,690	86,890	11,807	13,178	2,526	31,289	11,265,574
1974	3,453	192,404	11,091	31,803	82,570	47,554	12,050	19,792	3,753	17,507	7,117,790
1975	1,100	99,585	17,270	9,772	70,159	45,099	36,716	22,754	7,565	18,122	13,117,477
1976	2,931	69,500	21,631	94,184	425,617	-	19,832	25,595	3,020	12,581	14,069,569
1977	21,459	108,750	6,586	204,704	145,332	5,665	53,592	25,892	230	3,964	9,499,160
1978	1,596	-	23,164	326,621	81,862	25,154	139,297	10,422	48	14,422	14,694,221
AVERAGES	22,008	121,108	12,907	51,474	125,976	67,551	40,905	12,878	5,648	21,422	7,464,860

a. Total finfish category is the grand total of all species taken.

Table 7-18. Value (dollars) of major Georgia finfish species, 1963 - 1978 (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

YEAR	BLUEBACK HERRING	CATFISHES	FLOUNDERS	GROUPERS	MULLETS	BLACK SEA BASS	SHADS	STURGEONS	SPOTTED SEATROUT	SOUTHERN KINGFISH	TOTAL FINFISH[a]
1963	-	19,286	2,865	34	2,616	301	87,486	488	1,784	11,024	2,612,312
1964	-	16,753	2,339	23	26,160	224	99,768	337	574	9,153	2,973,071
1965	-	22,467	5,165	8	237	753	126,317	515	3,360	28,174	4,140,146
1966	-	21,262	5,838	-	199	523	99,797	328	1,426	18,224	3,882,653
1967	-	14,959	4,360	15,580	-	494	55,442	84	1,649	18,815	3,655,032
1968	-	12,387	4,636	2,698	20	2,306	138,673	82	652	14,705	6,210,433
1969	-	24,339	4,588	2,345	-	2,508	182,278	215	40	13,327	6,505,477
1970	-	23,629	6,062	7,863	-	2,485	140,168	755	19	15,324	4,163,387
1971	-	23,466	8,865	7,619	-	15,987	133,185	754	4,130	18,669	7,478,608
1972	-	25,158	12,835	11,372	-	28,487	111,468	1,764	6,495	25,298	6,805,911
1973	-	33,810	17,903	13,052	18	9,331	90,838	562	9,820	33,697	10,623,211
1974	-	42,756	15,892	18,080	315	16,968	62,820	486	5,790	30,393	7,095,175
1975	-	43,050	34,825	23,052	1,346	8,186	99,273	752	13,171	40,888	11,941,309
1976	-	42,776	24,231	2,930	2,643	5,996	57,285	530	15,189	47,917	12,374,548
1977	-	41,860	28,262	64,087	2,454	3,874	84,412	1,184	243	37,513	9,098,665
1978	-	20,391	41,123	93,703	708	12,218	154,805	2,785	75	61,744	14,567,119
AVERAGES		26,772	13,737	17,496	3,338	6,915	107,751	726	4,026	26,554	7,132,941

a. Total finfish category is the grand total of all species taken.

trend in landings over the past 18 years (Table 7-15).

The majority of the spot catch is sold fresh at the haul seine fishery sites. The seasonality of landings by haul seines often creates a market glut, resulting in lower prices, and in some cases fish must be discarded.

(3) Mullet. The primary fishery is located on the beaches of Horry County, South Carolina. The fishery in Georgia is limited due to prohibition of gill nets and haul seines. The majority of mullet are taken from September through November with haul seines, gill nets, and stop nets.

Mullet ranked among the top three South Carolina finfish species by weight from 1960 - 1977, ranking first in 1975 - 1977. Average annual landings ranged from 628,000 lb (284,854 kg) during 1970 - 1974 to a high of 2.1 million lb (0.95 million kg) during 1960 - 1964 (Table 7-15). Mullet landings averaged 1.6 million lb (0.7 million kg) annually during 1960 - 1977. Although subject to considerable variability from year to year, the fishery appears to be relatively stable (Fig. 7-7). Average annual value of South Carolina mullet landings for 1963 - 1978 was $126,000, ranking first in value for South Carolina finfish species (Table 7-17). Mullet value in 1975 - 1978 averaged $180,700 annually in South Carolina, again ranking first in total value. Average annual value of mullet landings in Georgia for 1963 - 1978 was $3,300, ranking eighth among finfish species (Table 7-18). Value of mullet landings in 1975 - 1978 averaged $1,800 annually in Georgia, again ranking eighth among finfishes.

The bulk of the mullet catch is sold fresh at haul seine fishery sites, although a small portion is frozen for sale during the off-season. Demand for mullet is apparently declining in South Carolina with more consumers showing a preference for spot. The market gluts noted for spot are even more pronounced for mullet. In the past, there was a large market for salted or "corned" mullet, but little is processed in this fashion at present. A growing demand exists for roe mullet for the overseas (primarily Japan) market. The present fishery seems limited more by the ability of the market to absorb greater quantities of fresh mullet than by stock abundance.

(4) Flounder. Coastal marine areas of South Carolina and Georgia fished by shrimp trawlers account for the majority of commercial flounder landings. These fish are most abundant inshore during spring and summer, moving offshore into deeper water in winter (Bearden 1960). Primary gear in both South Carolina and Georgia is the shrimp otter trawl. In South Carolina, some flounder are taken in gill and stop nets, but quantitative data are unavailable.

Figure 7-7 and Tables 7-15 and 7-16 present South Carolina and Georgia flounder landings for 1960 - 1977, respectively. South Carolina landings show a generally decreasing trend whereas those of Georgia have undergone a significant increase during this period. Georgia flounder landings averaged 50,000 lb (22,680 kg) annually during 1960 - 1977, ranking fourth in finfish landings. South Carolina flounder landings averaged 58,000 lb (26,308 kg) annually during the 1960 - 1977 period, ranking eighth among finfishes.

Average annual flounder values for 1963 - 1978 were $12,900 and $13,700 for South Carolina and Georgia, respectively. During 1975 - 1978, the average annual value of South Carolina flounder catches was $17,200, seventh in total value among finfish species. The Georgia flounder catch for this same period was valued at $32,100 and ranked fifth in finfish values. Most flounder are sold fresh in local retail markets and restaurants.

(5) Spotted Seatrout. These fish frequent all inshore coastal and estuarine waters of South Carolina and Georgia, favoring shorelines and oyster bars. Seatrout are found throughout the year, with spring and fall being periods of peak availability. In South Carolina, gill nets and stop nets are the primary gear used to capture spotted seatrout. Georgia commercial landings presumably are taken by a handline fishery because gill and stop nets are illegal and this species is not susceptible to capture by otter trawl.

As shown in Figure 7-7, landings of spotted seatrout in South Carolina declined after the mid-1960's, recovering somewhat in the early 1970's and then declining to the present. The severe winters of 1976 and 1977 are thought to have reduced numbers of this species. Georgia landings show an increasing trend for 1960 - 1977. Average annual landings for South Carolina during 1960 - 1977 were 23,000 lb (10,433 kg) and were ranked twelfth among major finfish species (Table 7-15). Georgia landings averaged 11,000 lb (4,989 kg) (1960 - 1977), ranking eighth among the eight major finfish species (Table 7-16).

Averaged annual value of spotted seatrout in South Carolina for 1963 - 1978 was $5,600 (Table 7-17). In Georgia, the average annual value was $4,000 for this period (Table 7-18). Most of these fish are sold fresh to local retail markets and restaurants.

(6) Potential For Expanded Commercial Fisheries in the Estuarine and Coastal Marine Areas of South Carolina and Georgia. The commercial finfisheries of the estuarine and inshore coastal areas of South Carolina and Georgia have the potential for increased production although a number of constraints will have to be removed if this is to occur. The majority of Georgia and South Carolina commercial fishermen have traditionally been oriented toward the shrimp, crab, and oyster fisheries with limited interest in pursuing finfish species. The legal restriction of gill netting in Georgia, except for shad and sturgeon, will severely limit any expansion of the commercial finfishery in that State. Mullet, bluefish, and spot fisheries show potential for increased landings, but marketing, gear restrictions, and potential conflicts with recreational fishermen presently preclude any significant expansion of fisheries for these species.

Considerable interest has been generated in the utilization of the large quantities of small fish caught and discarded by shrimp trawlers, but without development of processing technology and marketing channels, the realization of this goal seems remote.

Although not reflected in Georgia and South Carolina commercial landings, considerable quantities of Atlantic menhaden are caught in the coastal waters of the two States by purse-seiners who unload their catches at fish meal plants in North Carolina and Florida.

A fishery for the glass eel stages of the American eel is in the early development stages in estuarine areas of South Carolina. These animals are sold to Japanese and Taiwanese eel culturists. If high demand continues, this fishery could expand into a highly profitable, seasonal fishery.

b. Offshore Demersal Fisheries. One of the most significant recent developments in the commercial finfisheries of South Carolina and Georgia has been the expansion of the offshore demersal fishery for snappers and groupers and associated reef or "live-bottom" species. Increased landings of these species have been most pronounced in South Carolina since the development of a resident fleet of handline snapper/grouper vessels in mid-1976. Increases in Georgia landings of these species also occurred in 1976, although of a lesser magnitude than in South Carolina.

Landings of the snapper/grouper fleet in Charleston, South Carolina, for 1977 are presented in Tables 7-19 and 7-20 to illustrate species diversity and catch composition of this fishery. In 1977, this fishery was the most valuable commercial finfishery in South Carolina, exceeding the value of all other finfish landings combined. Similar data for Georgia are not available.

The major finfish species supporting the offshore demersal fishery are the snappers, groupers, porgies, and the black sea bass. The snappers, groupers, and porgies are fished primarily by handline vessels in the shelfbreak region in depths greater than 20 fathoms (36.6 m). The fishery for black sea bass is more inshore (10 - 20 fathoms) (18.3 - 36.6 m), and the primary gear is the fish trap.

Gear used, fishing locations, and landings will be detailed in the following species or species group sections.

(1) Snappers. There are three commercial species of snappers landed at South Carolina and Georgia ports: 1) red snapper, found in 18 - 40 fathoms (32.9 - 73.2 m) on the outer continental shelf; 2) silk snapper, found on the shelfbreak zone at 30 - 60 fathoms (54.9 - 109.8 m); and 3) vermilion snapper, found in 10 - 40 fathoms (18.3 - 73.2 m).

Snappers are most often associated with elevated bottom relief such as rock outcropping ledges and other "live-bottom" areas, although they are occasionally taken over smooth sand bottom. This fishery operates throughout the year with peak availability of red snappers in late winter and early spring. Vermilion snappers are caught in greatest numbers during the fall months.

Electric or hydraulic reels with baited hooks, whiteline fathometers, and LORAN A or C navigation equipment are important gear items in this fishery for location and relocation of fish schools and productive bottom areas. Fishing gear and techniques are detailed in Ulrich et al. (1977). Roller-rigged trawls have been used to fish these species in South Carolina and Georgia, but success is highly variable depending on the captain's knowledge of the bottom topography and fish distribution.

South Carolina and Georgia landings of snappers from 1960 - 1977 are shown in Figure 7-8. With the exception of high landings of snappers in South Carolina in 1961 and 1962, landings in that State were relatively low until 1976, when activity in this fishery expanded. Prior to 1977, Georgia landings were very low, ranging from less than 500 to 56,000 lb/yr (227 to 25,401 kg/yr). In 1977, Georgia landings increased to 87,000 lb (39,462 kg). Snappers ranked sixth and fifth in poundage annually in South Carolina and Georgia respectively during 1975 - 1977 (Tables 7-15 and 7-16).

(2) Groupers. There are six species of groupers landed commercially in the study area. These are as follows:

Table 7-19. Landings in pounds by hook and line snapper/grouper vessels in Charleston, South Carolina, 1977 (South Carolina Marine Resources Division, 1979, Charleston, unpubl. data).

MONTH	RED SNAPPER	SILK SNAPPER	BLACKFIN SNAPPER	VERMILION SNAPPER	GAG	SCAMP	SNOWY GROUPER	YELLOWEDGE GROUPER	WARSAW GROUPER	SPECKLED HIND	RED PORGY	OTHER SPECIES	TOTAL
Jan.	4,643			1,741	4,845	239			168	504	4,036	555	16,731
Feb.	3,964			1,426	2,195	19			1,481	320	8,474	3,015	20,894
Mar.	15,879	83	191	1,506	6,309	455			241	649	15,705	4,945	45,963
April	15,345	199	1,202	3,404	20,191	3,890			1,143	2,340	12,969	3,789	64,472
May	8,034	5,112	394	3,913	30,313	7,831			597	4,708	9,473	1,825	72,200
June	5,850	3,535	365	4,989	19,544	11,967	3,983	1,059	698	3,049	10,594	4,534	70,167
July	3,465	11,001	338	4,805	17,028	12,143	3,717	1,027	1,042	5,191	13,352	3,163	76,272
Aug.	3,023	6,567	217	4,698	15,174	12,105	8,546	2,120	1,653	5,859	23,625	5,562	89,149
Sept.	1,649	9,985	229	6,402	10,053	14,995	27,537	13,861	299	3,959	17,957	10,059	116,994
Oct.	1,535	9,573	19	4,976	5,587	2,922	15,453	4,427	65	2,271	17,599	3,376	67,803
Nov.	2,275	1,606	221	7,094	6,805	6,789	466	20	46	864	9,569	1,309	37,044
Dec.	3,125	1,099	71	8,018	4,852	4,852	1,728	584	98	1,337	10,122	1,785	35,358
TOTALS	68,787	48,760	3,247	52,972	142,896	75,894	61,410	23,098	7,531	31,051	153,475	43,917	713,047

Table 7-20. Percent species composition and total landings (pounds) for commercial snapper/grouper vessels unloading in Charleston, South Carolina, May 1976 - December 1977 (South Carolina Marine Resources Division, 1979, Charleston, unpubl. data).

MONTH	RED SNAPPER	SILK SNAPPER	BLACKFIN SNAPPER	VERMILION SNAPPER	GAG	SCAMP	SNOWY GROUPER	YELLOWEDGE GROUPER	WARSAW GROUPER	SPECKLED HIND	RED PORGY	OTHER SPECIES	TOTAL
May 1976	16.3	1.0		11.9	36.1	1.2				1.3	32.3		15,762
June 1976	9.0	0.4		13.8	41.3	10.4				4.1	20.9		26,661
July 1976	7.4	3.2		8.4	33.8	20.3				6.2	20.8		39,556
Aug. 1976	5.7	5.6	0.2	7.9	31.7	17.6				5.4	25.9		56,303
Sept. 1976	5.8	9.9		34.7	21.8	6.9				5.5	12.9	4.5	40,610
Oct. 1976	15.8	1.9	0.8	17.8	24.1	10.3	1.0			2.8	20.5	4.9	42,566
Nov. 1976	9.1		0.3	16.0	35.2	14.6			0.4	3.2	15.0	6.1	36,924
Dec. 1976	12.8		0.3	8.3	30.8	18.3			1.2	1.7	24.2	2.4	24,430
Jan. 1977	27.7			10.4	29.0	1.4			1.0	3.0	24.1	3.3	16,731
Feb. 1977	19.0			6.8	10.5				7.1	1.5	40.5	14.4	20,894
Mar. 1977	34.5	0.2	0.4	3.3	13.7	0.9			0.5	1.4	34.2	10.7	45,963
Apr. 1977	23.8	0.3	1.8	5.3	31.3	6.0			1.7	3.6	20.1	5.9	64,472
May 1977	11.1	7.1	0.5	5.4	42.0	10.8			0.8	6.5	13.1	2.2	72,200
June 1977	8.3	5.0	0.5	7.1	27.8	17.2	5.7	1.5	0.9	4.3	15.1	6.5	70,167
July 1977	4.5	14.4	0.4	6.3	22.3	15.9	4.9	1.3	1.4	6.8	17.5	4.1	76,272
Aug. 1977	3.4	7.4	0.2	5.3	17.0	13.6	9.6	2.4	1.8	6.6	26.5	5.9	89,149
Sept. 1977	1.4	8.5	0.2	5.5	8.6	12.8	23.5	11.8	2.5	3.4	15.3	8.3	116,994
Oct. 1977	2.3	14.1		7.3	8.2	4.3	22.8	6.5		3.3	25.9	4.6	67,803
Nov. 1977	6.1	4.3	0.6	19.1	18.4	18.3	1.2		0.1	2.3	25.8	3.6	37,044
Dec. 1977	8.8	3.1	0.2	22.7	13.7	7.2	4.9	1.6	0.3	3.8	28.6	5.1	35,358

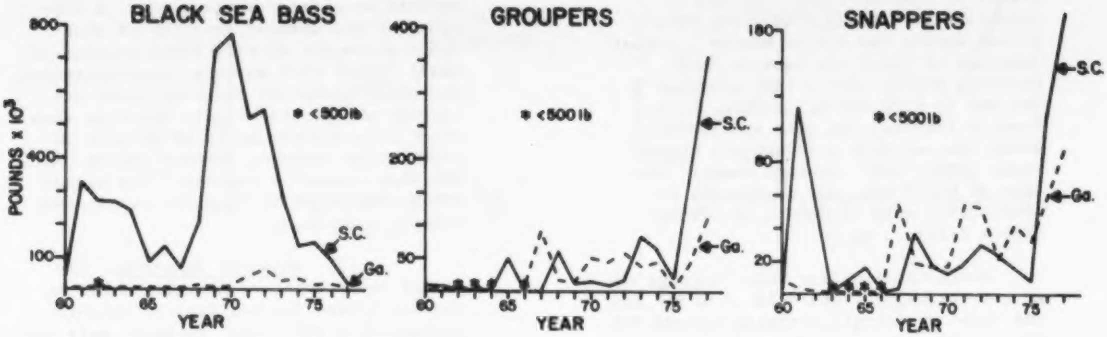

Figure 7-8. South Carolina and Georgia landings for major offshore demersal finfish, 1960 - 1977 (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

gag, scamp, speckled hind, Warsaw grouper, snowy grouper, and yellowedge grouper. The gag, scamp, speckled hind, and Warsaw groupers are usually associated with bottom structures, ledges, wrecks, etc., on the shelfbreak area in depths of 25 - 40 fathoms (45.8 - 73.2 m). The yellowedge and snowy groupers are animals of the shelf edge, occurring over hard or broken bottom. They are presently fished in 80 - 165 fathoms (146.4 - 301.9 m) throughout the year. The gear used in this fishery is the same as for snappers.

Grouper landings were generally stable at low levels until 1976 (Fig. 7-8), when landings climbed substantially in South Carolina with a less pronounced increase also evident in Georgia. South Carolina grouper landings in 1976 and 1977 were 181,000 and 352,000 lb (82,099.8 and 159,663.7 kg) respectively. Georgia grouper landings totalled 45,000 lb (20,411.6 kg) in 1976, increasing to 11,000 lb (49,894.9 kg) in 1977.

South Carolina grouper landings had an average annual value of $51,500 during 1963 - 1978, ranking fourth among finfishes (Table 7-17). For the period 1975 - 1978, this figure jumped to $158,800, ranking second among finfishes landed. Georgia grouper landings had an average annual value of $17,500 during 1963 - 1978, ranking fourth among finfish values (Table 7-18). During 1975 - 1978, this figure increased to $45,900 annually, ranking third among finfishes. Groupers are shipped fresh to wholesale distributors in New York and Florida. A limited amount is sold in local retail markets.

(3) Porgies. The red porgy is a major species of porgy landed in the study area. These fish occur on the outer shelf, over "live bottom," rocky outcroppings, etc., from 15 - 50 fathoms (27.4 - 91.5 m) all year. The gear used in this fishery is the same as for snappers.

Few commercial landings of red porgies were reported prior to the development of the South Carolina snapper/grouper fishery in mid-1976. South Carolina landings of porgies were approximately 102,000 lb (46,266.2 kg) in 1976, increasing to 168,000 lb (76,203.1 kg) in 1977. Georgia landings in 1976 and 1977 were 47,000 and 135,000 lb (21,318.7 and 61,234.7 kg) respectively (U.S. Department of Commerce, NOAA 1971 - 1980).

South Carolina porgy landings were valued at $46,000 in 1976, increasing to $72,200 in 1977. The Georgia porgy catch was worth $17,800 in 1976 and $73,800 in 1977. In 1977, the ex-vessel values of porgies in South Carolina and Georgia ranked fourth and third respectively among commercial finfish (U.S. Department of Commerce, NOAA 1971 - 1980).

The majority of porgy is shipped fresh to New York wholesalers. A portion of the catch is marketed locally in retail stores and restaurants.

(4) Black Sea Bass. The black sea bass is also a major commercial finfish species in the study area. These fish are found on the mid-shelf area at 10 - 15 fathoms (18.3 - 27.4 m). The fishery has traditionally been a winter and spring fishery by shrimp fishermen during the closed season for shrimp. Traps of modified crab trap design are used as the primary gear.

Figure 7-8 presents Georgia and South Carolina sea bass landings from 1960 - 1977. Landings for black sea bass in South Carolina reached their lowest point in the survey period in 1977, when only 16,000 lb (7,257.4 kg) were landed. The reasons for this decline are not known at this time, but it is probably a combined effect of reduced stock size and a reduction in fishing effort due to low prices during the winter months. Annual landings of black sea bass in South Carolina during 1960 - 1977 averaged 269,000 lb (122,016 kg) (Table 7-15). Georgia landings for this species are quite low and show a relatively steady trend (Fig. 7-8). Average annual landings of black sea bass in Georgia for 1960 - 1977 were 15,000 lb (6,804 kg) (Table 7-16).

South Carolina sea bass landings had an average value (1963 - 1978) of $67,600 and those of Georgia averaged over $6,900 for the same period (Tables 7-17 and 7-18). These fish are primarily shipped fresh to northern markets.

d. Commercial Anadromous Fisheries.

(1) American Shad. In both South Carolina and Georgia, the majority of the reported commercial shad catch is taken below river mile 40 in coastal rivers and estuaries. Although substantial fisheries exist above these areas, reporting of the catch is generally poor. Important shad rivers in Georgia are the Altamaha, Ogeechee, St. Marys, and Savannah. The Waccamaw-Pee Dee, Santee, and Edisto rivers are the most important South Carolina shad rivers.

In South Carolina, the shad season is generally 1 February - 20 April with numerous local exceptions. In Georgia, the season is earlier, 15 January - 15 April. Set and drift monofilament gill nets are the principal commercial gear in both South Carolina and Georgia.

Commercial landings of shad during 1960 - 1977 averaged 106,000 lb (48,081 kg) annually in South Carolina (Table 7-15). Georgia landings of shad for this same period more than tripled South Carolina production, averaging 360,000 lb (163,292 kg) annually (Table 7-16). Shad ranks as the number one finfish by weight in Georgia but only seventh in South Carolina. Shad landings from 1960 - 1977 for both States are shown in Figure 7-9.

Average annual value of South Carolina shad landings from 1963 - 1978 was $40,000, ranking fifth among finfish species (Table 7-17). During 1975 - 1978, the average annual value of South Carolina shad increased to $62,400, and its value rank increased to fourth. Georgia landings (1963 - 1978) were valued at an average of $107,800 annually, the top valued finfish species (Table 7-18). Recent declines in landings (Fig. 7-9) have reduced the annual value of the fishery. During 1975 - 1978, annual shad ex-vessel value averaged $98,900 in Georgia.

Georgia commercial shad catch is primarily shipped fresh to northeastern markets by primary wholesalers. A substantial but unknown quantity of shad taken above the 40-mile limit is sold in small retail fish markets, grocery stores, and other marketing channels which are largely unreported. South Carolina shad catch is primarily marketed locally in retail fish markets, grocery stores, etc. Roe shad command a substantially higher price than males because the roe is considered a delicacy.

(2) Atlantic Sturgeon. Although two species of sturgeon occur in the Sea Island Coastal Region, Atlantic sturgeon and shortnose sturgeon, only the Atlantic sturgeon is legally taken by commercial fishermen. The shortnose sturgeon is classified as an endangered species and laws in both South Carolina and Georgia prohibit the taking of this species.

The principal fishery for Atlantic sturgeon is located in the vicinity of Winyah Bay, South Carolina. Most fishing occurs in the ocean with nets set near the harbor jetties. Georgia's sturgeon fishery is of minor importance, with a small amount of these fish taken in the Savannah River.

Commercial landings for South Carolina and Georgia (1960 - 1977) are presented in Figure 7-9. Although considerable annual variation is evident, landings were relatively stable from 1960 to 1969. A low of 6,000 lb (2,721.5 kg) was reported in 1970 with the South Carolina fishery showing an increasing trend to the present. Average annual landings for South Carolina during 1960 - 1977 were 54,000 lb (24,494 kg) (Table 7-15). Average landings for 1975 - 1977 increased to 90,000 lb (40,823 kg) annually. Georgia landings were relatively stable for 1960 - 1977, averaging only 2,500 lb (1,134 kg) annually (Fig. 7-9).

The economic value of the sturgeon fisheries has been substantially underestimated because caviar has not been included in the valuation. It is estimated that if caviar values were included in commercial landings, the reported value of the fishery would more than triple. Value of the South Carolina sturgeon fishery (meat only) averaged $12,900 annually from 1963 to 1978 (Table 7-17). Recently, the South Carolina value has increased to an average of $21,200 annually during 1975 - 1978. Value of Georgia sturgeon landings averaged less than $800 annually during 1963 - 1978 (Table 7-18). Value of caviar to the fisherman in 1978 was $9.00 - $9.50 per pound.

Most of the meat (dressed by removing heads, tails, fins, and viscera) is shipped fresh to smoking operations in New York or Florida. Caviar is processed by rubbing the ovaries through a sieve to remove ovarian connective tissue. The brine

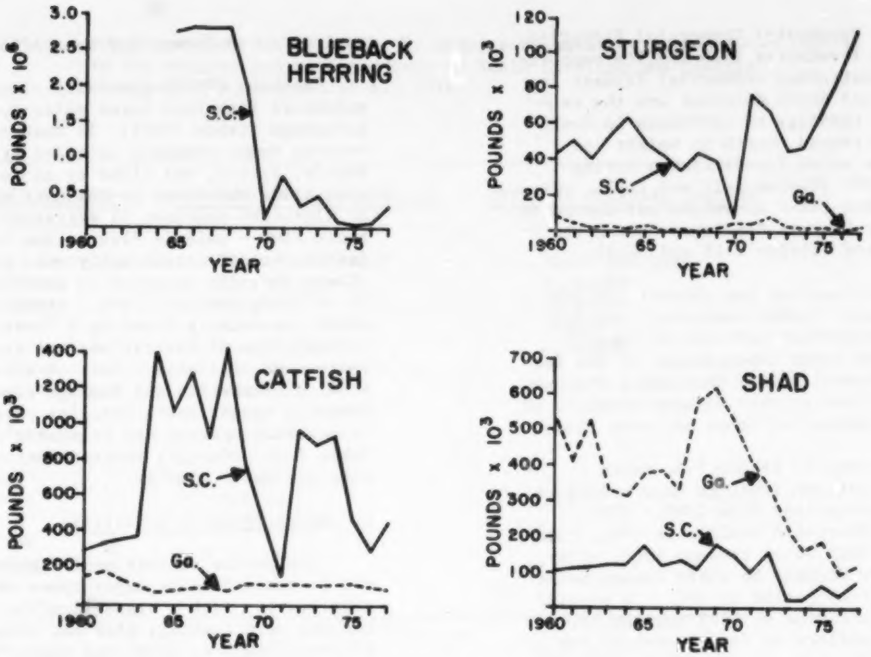

Figure 7-9. Anadromous fish landings in South Carolina and Georgia, 1960 - 1977 (U.S. Department of Interior, Fish and Wildlife Service 1942 - 1969; U.S. Department of Commerce, NOAA 1971 - 1980).

solution in which the eggs are rubbed serves to toughen the egg membrane so it will not rupture and allow the egg contents to leak out. Caviar is primarily sold locally to mail-order customers.

(3) Herring. The blueback herring is the major species taken in this fishery. South Carolina landings of blueback herring are mainly taken with hand seines and gill nets on the Santee River at Wilson Dam during 1 February - 1 May. There is no established fishery for herring in Georgia.

South Carolina blueback herring landings are shown in Figure 7-9. No landings were reported prior to 1965. A sharp decline is noted after 1970 which is attributable to legislation restricting the commercial harvest of herring in the Tail Race Canal of the Cooper River. This legislation was passed to insure that sufficient quantities of herring could be locked into lakes Marion and Moultrie to provide a forage base for lake populations of striped bass.

Average annual blueback herring landings for 1965 - 1969 in South Carolina were 2.63 million lb (1.19 million kg), declining to 327,000 and 136,000 lb (148,324 and 61,688 kg), respectively, in 1970 - 1974 and 1975 - 1977 (Table 7-15). Average annual value of the South Carolina blueback herring catch in 1965 - 1969 was $49,100. The 1970 - 1974 catch was valued at $7,100 annually, declining to $6,800 in 1975 - 1977 (Table 7-17). Herring is used locally for crab pots and catfish trap bait.

e. Commercial Catadromous Fisheries. The American eel is a common species in the fresh and estuarine waters of South Carolina and Georgia, but presently supports only a limited commercial fishery. The only present fishery for yellow eels (sexually immature, freshwater form) is located in the Cooper River system and lakes Marion and Moultrie. Current South Carolina and Georgia laws discourage further development of the yellow eel fishery in other river systems by banning the use of eel traps in freshwater areas. Most successful fisheries for this stage of eel are located in fresh water, where the greatest concentrations of the larger female eels occur.

A seasonal fishery for glass eels, the unpigmented juveniles of American eels, is developing and may show promise of becoming a substantial fishery in South Carolina. Japanese and Taiwanese eel culturists have created a strong demand through favorable prices for these animals.

f. Freshwater Commercial Fisheries. The only freshwater fish species supporting a substantial commercial fishery in Georgia and South Carolina are the catfishes. Landings of catfishes in South Carolina ranked fourth in weight and second in value for finfishes during 1960 - 1977 (Tables 7-15 and 7-17). Catfish ranked third in weight and second in value for Georgia finfishes during the same period (Tables 7-16 and 7-18).

White catfish and channel catfish are the most common commercial species in the freshwater portions of coastal rivers and large impoundments of the Sea Island Coastal Region throughout the year. The gear used in this fishery consists of catfish baskets or traps and trot lines.

As shown in Figure 7-9, South Carolina catfish landings have undergone major fluctuations from 1960 - 1977. Landings increased rapidly in 1964, holding at a high level through 1968, after which they dropped to their lowest point in the survey period in 1971. A partial recovery occurred in 1972 through 1974. Catfish landings in South Carolina for 1960 - 1977 averaged 712,000 lb (322,956 kg) annually, ranging from a high of 1.1 million lb (0.5 million kg) annually in 1965 - 1969 to a low of 402,000 lb (182,343 kg) annually for 1975 - 1977 (Table 7-15). Georgia landings of catfish were essentially stable during 1960 - 1977, averaging 97,000 lb (43,998 kg) annually (Table 7-16). The South Carolina average annual value for catfishes during 1963 - 1978 was $121,100 (Table 7-17). Georgia average annual value for catfishes during 1963 - 1978 was $26,800 (Table 7-18).

Catfish are pan-dressed for fresh or frozen retail sales in fish markets and restaurants, primarily a local market.

II. RECREATIONAL FISHERIES

A. MARINE RECREATIONAL FISHERY RESOURCES

Recreational fishing is an important outdoor activity within the coastal regions of South Carolina and Georgia. Consequently, the marine and estuarine resources which support this activity are extremely important components of the total fishery resources. The principal species supporting marine recreational fisheries include finfish, shrimp, crabs, and shellfish (primarily oysters and clams).

According to Bearden (1969), approximately 400 species of fish are found in the marine and estuarine waters of South Carolina. Dahlberg (1975) lists 375 species of fish from the coastal regions of Georgia. Many of these species are important to the recreational fisheries, either as species utilized directly by anglers or as forage for sportsfish.

Bearden (1969) generally classifies saltwater fish into three major ecological groupings (Table 7-21): 1) inshore fish - species found commonly in tidal streams, sounds, inlets, and close to shore in the open ocean which may be resident species or migratory species; 2) migratory offshore fish - pelagic fish seldom found inshore except occasionally when young (these fish are seasonal in occurrence); 3) offshore demersal fish - those species which are usually found in a "live bottom" type of habitat and are generally year-round residents. Data on the seasonal distribution and average sizes of commonly caught South Carolina recreational fish species are presented in Table 7-22. Georgia recreational fish data are quite similar.

1. Major Types of Activities

The Marine recreational fisheries can be classified by major types of activities. Such a classification would include surf fishing; pier and bridge fishing; inshore, inlet, and sound fishing; offshore trolling; offshore bottom fishing; artificial reef fishing; party boat fishing; shrimping; crabbing; and shellfish harvesting.

Even though the offshore recreational fisheries for pelagic and demersal finfish species occur outside of the characterization area, descriptions of these fisheries are included because of their economic importance to the coastal area. Charter and head boat operations as well as marinas, bait and tackle businesses, marine fuel sales, and boat sales and services are components of an important marine recreational industry which is based within the coastal area. A substantial portion of the economies of some coastal areas is directly dependent upon these components as they relate to the offshore fisheries.

a. Surf Fishing. This is a popular activity along the beaches and barrier islands of South Carolina and Georgia. Species commonly taken by surf fishermen include kingfishes, Atlantic croaker, spot, red drum, flounders, bluefish, pompanos, and spotted seatrout.

Popular surf fishing locations in South Carolina include the Grand Strand area of Myrtle Beach and the beaches of Bull, Cape, Dewees, Morris, Kiawah, Edisto, Hunting, and Hilton Head islands. Along the coast of Georgia, the following areas are known surf fishing locations: Savannah Beach, St. Catherines Island, Cabretta Inlet, Egg Island, Sea Island, St. Simons Island, Jekyll Island, and Cumberland Island (A. Branch and C. D. Harris, 1978, Georgia Department of Natural Resources, Brunswick, pers. comm.).

Table 7-21. Common recreational finfish, by major ecological type, found in the coastal and marine waters of South Carolina and Georgia (Bearden 1969, Johnson et al. 1974).

INSHORE SPECIES	OFFSHORE PELAGIC SPECIES	OFFSHORE DEMERSAL SPECIES
Spotted seatrout	Spanish mackerel	Black sea bass
Black drum	King mackerel	Snappers
Kingfishes	Dolphin	Porgies
Red drum	Sharks	Grunts
Spot	Bluefish	Groupers
Sheepshead	Jacks	
Atlantic croaker	Wahoo	
Pigfish	Tunas	
Flounders	Barracuda	
Silver perch	Cobia	
Tarpon	Sailfish	
Pompanos	Marlin	
Cobia		
Bluefish		
Spadefish		
Sharks		

Table 7-22. Seasonal distribution and average sizes of saltwater fish commonly caught in South Carolina (Bearden and McKenzie 1973).

SPECIES	SEASON	AVERAGE WEIGHT (pounds)
Amberjacks	All year offshore	2.0 - 30.0
Barracudas	May through October	5.0 - 25.0
Bluefish	April through October	0.5 - 2.0
Red drum	All year - best Spring and Fall	1.5 - 30.0
Cobia	May through October - best May and June	3.0 - 40.0
Atlantic croaker	April through November	0.25 - 0.50
Dolphin	March through October	5.0 - 20.0
Black drum	April through November	5.0 - 20.0
Flounders	April through October	0.5 - 3.0
Groupers	All year offshore	5.0 - 25.0
Grunts	All year offshore	0.25 - 2.0
Jack crevalle	May through October	1.0 - 5.0
Ladyfish	May through October	0.5 - 1.5
Blue marlin	April through October	150.0 - 350.0
White marlin	April through October	30.0 - 70.0
King mackerel	May through December	5.0 - 20.0
Spanish mackerel	May through October, peak July - September	1.0 - 3.0
Pompanos	May through October	0.25 - 2.0
Porgies	All year offshore	0.25 - 4.0
Striped bass	Best Fall and Winter, tidal rivers	3.0 - 15.0
Sailfish	May through November	24.0 - 40.0
Black sea bass	All year	0.5 - 3.0
Shad	March through May	1.0 - 5.0
Sharks	All year, peak May - October	- -
Sheepshead	All year, best April - October	0.5 - 5.0
Snappers	All year offshore	10.0 - 20.0
Spadefish	April through October	1.0 - 5.0
Spot	April through December, peak September - November	0.25 - 0.50
Tarpon	July through September	15.0 - 80.0
Tripletail	May through October	1.0 - 3.0
Weakfish	April through November	0.5 - 3.0
Spotted seatrout	All year, best October - December	0.5 - 2.0

Table 7-22. Concluded

SPECIES	SEASON	AVERAGE WEIGHT (pounds)
Atlantic bonita	All year offshore	5.0 - 15.0
Tunas	April through December	5.0 - 15.0
Wahoo	June through December, best June - September	15.0 - 40.0
Kingfishes	April through November	0.25 - 1.0

1 lb = 0.45359 kg

During 1968, approximately 42,000 residents of South Carolina participated in surf fishing (Bearden 1969). Comparable data for Georgia do not currently exist.

b. Pier Fishing. A second major type of marine fishing activity is that associated with piers. In South Carolina, Bearden (1969) identified 15 fishing piers operating in 1968, while during 1974, a total of 12 fishing piers were in operation (Hammond and Cupka 1977). Of these 12, only one is located in the South Carolina Sea Island Coastal Region - Isle of Palms. The remaining 11 are located adjacent to the characterization area along the Myrtle Beach - Grand Strand. The principal species taken from pier fishing in decreasing order of abundance were spot, Atlantic croaker, kingfishes, silver perch, Florida pompano, and bluefish.

Bearden (1969) estimated that 20,000 angler days were spent on South Carolina piers in 1968. During 1974, a total of 228,000 angler days were expended on the 12 piers in operation (Table 7-23). The economic impact of the South Carolina pier fishery during 1974 was estimated at $2.4 million (Hammond and Cupka 1977).

In Georgia, there are two ocean fishing piers (Freeman and Walford 1976a,b). A third pier at Savannah Beach was destroyed by a storm some years ago and it has never been rebuilt. The two existing piers are located on St. Simons and Jekyll islands. Officials responsible for these piers indicated that the piers are public use facilities with no user fees involved and consequently no statistical data on angler utilization. They did indicate, however, that both piers were used heavily by anglers.

c. Fishing from Bridges. Many bridges in South Carolina and Georgia are used as fishing platforms, some of them incorporating specially constructed fishing catwalks. Reported locations where bridge fishing occurs are presented in Table 7-24. The catch from bridges is similar to that of inshore small boat fishing with sheepshead, cobia, spotted seatrout, red drum, and other species of sciaenids being the most sought after species. Bridges provide popular fishing platforms for the capture of shrimp and blue crabs, in addition to finfish.

d. Inshore, Inlet, and Sound Fishing. This is a major type of recreational fishing in the coastal areas of South Carolina and Georgia. Most of this type of fishing is done from small boats and, in terms of number of participants, the small boat fishery constitutes the largest segment of the recreational fishery. Species commonly taken include spotted seatrout, red drum, flounders, spot, Atlantic croaker, kingfishes, sheepshead, bluefish, and cobia. Bearden (1969) estimated that 121,000 South Carolina residents engaged in small boat fishing during 1968.

Data gathered during coastal flyovers in 1973 reveal the distribution of small boat activity in the inshore coastal waters of South Carolina during this period (Table 7-25). Similar data for the coastal area of Georgia do not exist (C. D. Harris, 1978, Georgia Department of Natural Resources, Brunswick, pers. comm.).

An economic component of the small boat fishery includes the rental of boats to resident and nonresident anglers. During 1977, there were four boat rental businesses located in coastal South Carolina (Moore 1977). Freeman and Walford (1976a,b) list 18 areas in Georgia where boat rentals are available.

e. Offshore Trolling. This activity is at its peak during the period of April through November off the coasts of South Carolina and Georgia. Species sought by anglers include Spanish mackerel, king mackerel, and bluefish close to shore while further offshore, dolphin, tunas, wahoo, sailfish, marlins, and barracudas comprise the catches. During 1968, approximately 26,000 residents of South Carolina, utilizing more than 2,700 private and charter boats, engaged in

Table 7-23. Angler attendance (angler days) by month for the 12 fishing piers operating off South Carolina, April through November, 1974 (Hammond and Cupka 1977).

PIER	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	TOTAL
Second Avenue	747	496	449	825	975	825	876	320	5,513
Crescent Beach	147	159	650	1,285	956	648	748	119	4,748
Cherry Grove	1,386	1,571	3,519	6,230	3,188	4,639	6,346	1,815	28,694
Inlet	344	542	1,123	2,054	907	1,375	2,923	582	9,850
Isle of Palms	951	1,554	2,647	2,041	1,469	950	869	699	11,180
Kingfisher	0	1,719	2,906	3,855	3,064	2,822	6,727	3,586	24,679
Surfside Beach	5,161	3,625	6,006	10,927	5,266	493	6,840	2,919	41,237
M. B. State Park	1,599	2,237	4,007	5,165	3,425	3,229	5,163	2,558	27,383
Windy Hill	1,659	1,768	3,414	4,684	3,579	2,615	4,935	1,348	24,002
Kits	589	299	1,311	1,829	1,263	487	1,246	0	7,024
Tilghman Beach	122	418	872	1,433	965	489	1,121	222	5,642
Springmaid	5,044	4,211	3,629	5,389	5,816	3,861	7,234	2,625	37,959
Totals	17,749	18,599	30,533	45,717	30,873	22,433	45,214	16,793	227,911

Table 7-24. **Reported locations by county in South Carolina and Georgia coastal areas where recreational fishing occurs from bridges (Georgia Sea Grant Program and University of Georgia 1976; D. M. Cupka, 1978, South Carolina Marine Resources Division, Charleston, unpubl. data).**

- SOUTH CAROLINA
  - Georgetown County
    - Highway 46 at Pawleys Island Creek
    - Old Highway 17 at Pee Dee River
    - Highway 17 at South Santee River
  - Charleston County
    - Highway 703 at Breach Inlet
    - Highway 1028 at James Island Creek
    - Highway 171 at James Island Creek
    - Highway 700 at Bohicket Creek
    - Highway 17 at Rantowles Creek
    - Highway 174 at Russell Creek
  - Colleton County
    - Highway 26 at Ashepoo River
  - Beaufort County
    - Highway 16 at Combahee River
    - Highway 802 at Lucy Point Creek
    - Highway 21 at Beaufort River
    - Highway 21 at Harbor River
    - Highway 406 at Johnson Creek
    - Highway 170 at Broad River
    - Highway 170 at Chechessee River
    - Highway 278 at Mackays Creek
    - Highway 406 at Fripp Inlet
- GEORGIA[a]
  - Glynn County
    - Highway 972 (Torras Causeway) at Terry Creek
    - Highway 972 at Back River
    - Highway 972 at Little River
    - Highway 972 at Mackay River
    - Highway 972 at Frederica River
    - Highway 50 at Cedar Creek
    - Highway 50 at Jekyll River

a. Additional information on the other Georgia coastal counties is currently being compiled by the University of Georgia Marine Extension Service.

offshore trolling (Bearden 1969). A survey of offshore fishing in Georgia is currently underway and the data will be available in the near future (C. D. Harris, 1978, Georgia Department of Natural Resources, Brunswick, pers. comm.).

f. Offshore Bottom Fishing. This type of fishing is excellent year around off the coast when weather permits access to the prime fishing areas. The principal areas fished are the "Blackfish Banks" (rough bottom areas composed of rock outcroppings and corals) located 5 - 20 mi (8 - 32 km) offshore and the "Snapper Banks" (natural reef areas, rocky ledges, and drop-offs) which parallel the coast some 20 to 60 mi (32 to 96 km) offshore. Species commonly caught in these areas include black sea bass, groupers, snappers, porgies, and grunts. Bearden (1969) estimated that 20,000 South Carolina residents participated in this fishery during 1968.

There are numerous artificial fishing reefs located off the coast of South

Table 7-25. **Small boat activity in the coastal waters of South Carolina (April through November 1973) by percent of total boats observed. Data were obtained through regular coastal flyovers (D. M. Cupka, 1978, South Carolina Marine Resources Division, unpubl. data).**

AREA	PERCENT OF TOTAL BOATS OBSERVED
Murrell's Inlet	23.6
Wando River	7.9
Little River	6.8
Sullivans Island	5.3
Myrtle Beach	4.7
Dewees and Capers islands	4.6
Winyah Bay	4.6
Broad River	3.5
Charleston Harbor	3.0
Isle of Palms	3.0
Cape Romain Area	2.9
Cooper River	2.9
North Inlet	2.9
St. Helena Sound	2.7
Hilton Head Island and Calibogue Sound	2.6
Stono River	2.6
Edisto Area	2.5
Port Royal Sound	2.5
Bull Point	2.2
Pawley's Island	2.1
Chechessee River	1.8
Kiawah Island	1.3
North and South Santee rivers	1.2
Hunting Island	1.1
Folly River	0.7
Fripp Island	0.5
Morris Island	0.5

Carolina and Georgia (Table 7-26; also see Atlas plates 27 and 29). These reefs provide easily located and productive fishing sites for offshore fishermen. They attract additional anglers to an area and provide increased fishing opportunities (Buchanan et al. 1974).

Species caught at artificial reef sites include king mackerel, Spanish mackerel, cobia, bluefish, black sea bass, amberjacks, spadefish, flounders, spotted seatrout, and sheepshead. The reefs are also popular sites for spearfishing, underwater photography, and SCUBA diving to explore and examine the various forms of marine life present.

Studies have been conducted or are currently being conducted to determine angler utilization and the associated economic impacts of these reefs. A study recently completed in South Carolina indicated that an estimated 34,000 artificial reef fishing trips were made by private boat, head boat, and charter boat anglers during 1977 (Liao and Cupka 1979). The direct economic impact of these reefs was estimated at approximately $5 million annually. A similar study is currently being conducted by the Georgia Department of Natural Resources.

Party boat fishing off the coasts of South Carolina and Georgia has grown significantly within the last decade. There are two basic types of boats which constitute this segment of the fishery. The "head" boat generally carries from 40 to 100 people on a single trip who are charged on a per-person basis. Head boats fish primarily for demersal species such as those discussed earlier. The "charter" boat usually carries four to six persons and a set trip fee is charged. Charter boats generally troll for those species discussed in the section on offshore trolling, although some bottom fishing does occur.

During 1968, [illegible] charter boats and 15 head boats operated out of South Carolina ports (Bearden 1969). During 1977, 49 charter boats and 18 head boats were operating out of these same ports (Moore 1977). In addition to an increase in the number of head boats during this period,

Table 7-26. Data on artificial reefs located off the coasts of South Carolina and Georgia (Myatt 1978, Georgia Department of Natural Resources 1976c).

REEF DESIGNATION	LOCATION		MATERIALS
Little River Reef	33°48.7'N	78°31.3'W	25,000 bailed automobile tires
Paradise Reef	33°30.7'N	78°57.7'W	60,000 automobile tires, 8 steel hulls, 5 cement mixer drums, concrete culvert
Ten Mile Reef	33°26.1'N	78°52.6'W	24,000 automobile tires, 3 steel ship hulls
Pawleys Island Reef	33°25.6'N	79°00.5'W	31,000 automobile tires, 4 steel ship hulls
Capers Island Reef	32°45.0'N	79°34.5'W	30,000 automobile tires, 9 steel ship hulls, 2 truck bodies, 1 steel caisson, 100 steel milk crates
Kiawah Reef	32°28.9'N	79°58.5'W	47,000 automobile tires, 70 automobile bodies, 6 steel ship hulls, 12 tons concrete culvert
Hunting Island Reef	32°12.9'N	89°19.8'W	30,000 automobile tires, 7 steel ship hulls, 8 steel barge sections
Fripp Island Reef	32°15.6'N	80°22.1'W	8,000 automobile tires
Hilton Head Reef[a]	31°59.8'N	80°35.8'W	8,000 automobile tires
KC Reef	31°50.8'N	80°46.7'W	5,000 tire units
L Reef	31°45.5'N	80°36.5'W	2,000 tire units, 2 steel barges
J Reef	31°36.3'N	80°48.0'W	440-foot liberty ship hull, 1 wooden vessel, 1,000 tire units
F Reef	31°05.8'N	81°13.4'W	6,000 tire units
G Reef	30°58.2'N	80°58.0'W	3,000 tire units, 440-foot liberty ship hull, 2 steel ship hulls
A Reef	30°55.9'N	81°16.2'W	1,000 tire units
WR2 Reef	30°51.0'N	81°09.6'W	1,500 tire units, 1 steel ship wreck

[a] This reef jointly constructed and maintained by South Carolina and Georgia.

there has also been a trend towards larger head boats capable of carrying more anglers. Data on the number of head and charter boats operating out of South Carolina ports during 1968 and 1977, along with their associated economic impacts, are presented in Table 7-27.

In Georgia, there are currently two head boats operating (C. D. Harris, 1978, Georgia Department of Natural Resources, Brunswick, pers. comm.), and the number of charter boats increased from 8 to 17 in the period from 1970 to 1973 (Brown and Holemo 1975). During 1978, there were 20 charter boats reported operating out of Georgia (Georgia Department of Natural Resources 1978).

The major party boat centers in South Carolina are located at Little River, Murrells Inlet, Georgetown, Charleston, Fripp Island, and Hilton Head Island. The major party boat centers in Georgia are located at Savannah Beach, Turner Creek, Thunderbolt, Troup Creek, and Jekyll Island (Freeman and Walford 1976a,b).

Table 7-27. Data on head boats and charter boats operating out of South Carolina ports during 1968 and 1977 (Bearden 1969, Moore 1977, Liao and Cupka 1979).

	1968	1977
Number of Charter Boats	27	49
Total Number of Fishing Trips	2,430	3,387[a]
Average Total Expenditure/Trip	$ 183.00	$ 663.00[a]
Estimated Total Annual Expenditures	$ 444,690.00	$2,245,888.00[a]
Number of Head Boats	15	18
Total Number of Angler Days	52,080	122,647[b]
Average Daily Expenditures/Angler	$ 23.00	$ 32.66
Estimated Total Annual Expenditures	$1,197,840.00	$4,006,366.00[b]

a. Adjusted by a factor of $^{49}/32$; 49=total number of charter boats operating in South Carolina during 1977 as reported by Moore (1977), 32=number of charter boats reported on by Liao and Cupka (1979).

b. Adjusted by a factor of $^{18}/16$; 18=total number of head boats operating in South Carolina during 1977 as reported by Moore (1977), 16=number of head boats reported on by Liao and Cupka (1979).

In additon to the various finfish species, brown shrimp, white shrimp, blue crabs, and hard clam also support extensive recreational fisheries in the coastal area.

g. Recreational Shrimping. This is a popular form of outdoor recreation in the coastal regions of South Carolina and Georgia. Most of the tidal creeks provide good shrimping opportunities. The major types of gear used include seines, cast nets, and baited drop nets. Otter trawls and channel nets are occasionally used to harvest shrimp recreationally.

A survey of the recreational shrimp fishery in South Carolina was conducted during 1974 (D. M. Cupka, 1974, South Carolina Marine Resources Division, Charleston, unpubl. data). Major results of this survey are presented in Table 7-28. Indications are that the magnitude of the total recreational shrimp catch in South Carolina during 1973 was at least 10% of that of the commercial fishery (Eldridge et al. 1974).

Since 1978, Georgia has required recreational shrimpers to purchase a personal commercial saltwater fishing license. In the period from 1 April 1978 through 15 October 1978, approximately 1,100 such licenses were issued (R. K. Mahood, 1978, Georgia Department of Natural Resources, Brunswick, pers. comm.), but to date no survey has been conducted of this aspect of Georgia's marine recreational fisheries. South Carolina does not have such a license at this time.

h. Blue Crabs. This is another important marine resource which is harvested recreationally. Crabs generally have a ubiquitous distribution in coastal waters. The majority of the crabs which enter the recreational fishery are taken in the period from April through November with baited drop nets, crab traps, or handlines and dipnets (Cupka 1977). No information is currently available on the recreational harvest of blue crabs or the number of participants in the fishery for either South Carolina or Georgia.

i. Shellfish. The most popular types of shellfish harvested recreationally include oysters and hard clams. South Carolina maintains a number of public oyster grounds and State shellfish grounds which are areas where the public can harvest shellfish recreationally (Cupka and Pridgen 1976). During 1978, six additional areas were

Table 7-28. Summarized data from a 1974 survey of the recreational shrimp fishery in South Carolina (D. M. Cupka, 1974, South Carolina Marine Resources Division, Charleston, unpubl. data).

Major gear types used to shrimp recreationally, and percent usage reported:
cast net (66.7%), seine (16.4%), drop net (15.6%), otter trawl (1.3%).

Average annual catch per respondent:
48.6 lb (22.0 kg) (heads-on).

Principal county in which respondent shrimped, by percent:
Charleston (52.6%), Beaufort (25.4%), Georgetown (9.4%), Jasper (7.2%), Horry (3.6%), and Colleton (1.8%).

Area or platform from which shrimping occurred, by percent:
boat (66.5%), shore (20.8%), pier or dock (10.6%), bridge (2.1%).

Principal months during which fishing occurred, by percent:
March (0.1%), April (0.4%), May (2.0%), June (9.8%), July (16.9%), August (23.0%), September (24.8%), October (13.7%), November (7.4%), December (1.9%).

Average number of trips annually per respondent:
9.2.

Average catch per trip:
5.3 lb (2.4 kg) (heads-on).

Projected total number of trips annually:
155,117.

Projected total annual catch:
815,717 lb (370,001 kg) (heads-on).

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established, bringing the total number of such areas to 28, with 15 public oyster grounds and 13 State shellfish grounds (Table 7-29). The locations of these areas are shown on Atlas plates 31 - 40. No estimates are currently available on the recreational harvest of shellfish from these public shellfish areas. Georgia does not maintain any comparable specific areas for recreational shellfish harvesting (C. D. Harris, 1978, Georgia Department of Natural Resources, Brunswick, pers. comm.). Estimates on the number of residents participating in marine recreational shellfishing for South Carolina and Georgia are 283,000 and 251,000, respectively (U.S. Department of Commerce, NOAA 1977b).

2. Recreational Harvest of Marine Species

Since 1970, a number of surveys has been conducted that have provided information on the recreational harvest of finfish and shellfish in South Carolina and Georgia. Unfortunately, these surveys were conducted during different years, involved different segments of the recreational fisheries, and covered different geographical areas. As a result, no comprehensive marine recreational harvest data are available for all segments of the recreational fisheries for South Carolina and Georgia specifically. Data from each of these partial surveys are summarized in the following sections.

During 1972 - 1974, an average annual catch of 787,650 lb (357,270 kg) of finfish was harvested by the headboat fishery operating off South Carolina (Table 7-30). Average catch rates during this period ranged from 20.0 - 36.6 lb (9.1 - 16.6 kg) of fish per angler day.

During 1974, an 8-month survey was conducted of the pier fishery in South Carolina (Hammond and Cupka 1977). The projected total catch for the six dominant genera of fish caught during the survey was approximately 841,000 individual fish (Table 7-31). This represented 91.2% of the total projected catch during the survey. Biomass for the entire survey period was calculated for spot, Atlantic croaker, kingfishes, and silver perch. Over 191,000 lb (86,635.6 kg) of these fish were estimated to have been landed on the piers. Spots account for the largest proportion, 91,000 lb (41,276 kg), while Atlantic croaker followed in second place at 54,000 lb (24,493 kg). Kingfish, which ranked

Table 7-29. South Carolina coastal areas available for recreational shellfish harvesting (South Carolina Marine Resources Division, Charleston, unpubl. data).

COUNTY	DESIGNATION	TYPE
Horry and Georgetown	North Murrells Inlet	POG[a]
Georgetown	Allston Creek	POG
Georgetown	Clam Bank Flats	POG
Charleston	Alligator Creek	MSSG[b]
Charleston	Matthews Cut	POG
Charleston	Sewee Bay	POG
Charleston	Hamlin Creek	POG
Charleston	Conch Creek	MSSG
Charleston	Folly River	POG
Charleston	Folly River	MSSG
Charleston	Cole Creek	MSSG
Charleston	Kiawah Island	POG
Charleston	Leadenwah Creek	POG
Charleston	Toogoodoo Creek	MSSG
Colleton	Ashepoo River	POG
Colleton	Ashe Island	POG
Beaufort	Whale Branch	POG
Beaufort	Station Creek	MSSG
Beaufort	Capers Creek	MSSG
Beaufort	Lucy Point Creek	MSSG
Beaufort	Old House Creek	MSSG
Beaufort	Distant Island Creek	MSSG
Beaufort	Marsh Island	MSSG
Beaufort and Jasper	Euhaw Creek	MSSG
Beaufort	Habersham Creek	MSSG
Beaufort	Chechessee River	POG
Beaufort	Last End Point	POG
Beaufort	May River - Bull Creek	POG

a. POG = Public Oyster Grounds
b. MSSG = Marked State Shellfish Grounds

third in both number of individuals harvested and in poundage, produced an estimated 38,000 lb (17,236 kg). The total catch for silver perch, which is a notably smaller species of fish, was estimated to be 8,000 lb (3,629 kg). This 191,000 lb (86,636 kg) represents only 83% of the individual fish harvested during the 8-month period. Thus, a reasonable estimate would be that over 220,000 lb (99,790 kg) of fish were harvested from the piers during the course of this survey.

A survey of South Carolina's recreational shrimp fishery was conducted during 1974. Information on the recreational harvest by this fishery is presented in Table 7-28.

Information on the recreational harvest of finfish in Georgia during 1970 indicated an annual harvest of 2,245,000 lb (1,018,309 kg) (Morrow 1972). These data are a result of harvest estimates made by field personnel of the Georgia Department of Natural Resources (Table 7-32).

There are other data available which provide some insight into the total recreational finfish harvest for the south Atlantic region (Cape Hatteras to south Florida) during 1970. This information, along with a comparison of the commercial harvest for the same area, is presented in Table 7-33. The accuracy and reliability of the recreational catch data in Table 7-33 are certainly less than that of the commercial catch data, because of inherent sampling errors. Nevertheless, it is difficult to ascribe the difference between the two catches of the selected species, a factor of 10, to sampling error alone. It is readily apparent that the recreational harvest of these particular species greatly exceeds that of the commercial harvest in the South Atlantic region, and that the recreational harvest represents a significant portion of the total finfish resource.

During 1975, the National Marine Fisheries Service conducted a survey of recreational fishing which will provide

Table 7-30. Recreational catch data from the South Carolina headboat fishery, 1972 - 1974 (Huntsman 1976a,b).

SPECIES	1972 CATCH (pounds)[a]	1973 CATCH (pounds)	1974 CATCH (pounds)
Porgies	310,841	356,576	277,607
Grunts	111,658	22,658	53,370
Vermilion snapper	40,273	43,845	55,442
Black sea bass	- - - -[b]	- - - -	439,229
Groupers	155,075	138,241	117,906
Red snapper	18,872	27,672	14,081
Others	34,019	57,483	88,011
TOTAL	670,738	646,566	1,045,646
Pounds/Angler Day	36.6	31.0	20.0

a. 1 lb = 0.45359 kg.

b. Black sea bass landing data not collected during 1972 and 1973.

data on the numbers and weights of finfish species caught by States instead of by region. As of 1979 these data are still in a preliminary form and are subject to revision. It is anticipated that the survey results will be published in the near future.

3. Marine Recreational Fisheries Participation

Since 1968, a number of surveys have been conducted which have provided information on participation in various segments of the marine recreational fisheries of South Carolina and Georgia. This information is summarized in Table 7-34.

In addition to resident participation in the marine recreational fisheries, a limited amount of data exists on participation in these fisheries by nonresidents. A 1968 North Carolina survey indicated that 36,000 North Carolina residents fished in the marine and estuarine waters of South Carolina during this period (Hayne 1968). An estimated total of 828,000 nonresidents participated in the marine recreational fisheries of South Carolina and Georgia during 1973-74 (Table 7-35).

Insight into the rate of growth in participation in the saltwater sport fisheries of the South Atlantic region (Cape Hatteras to South Florida) can be obtained by examining the national surveys conducted during 1960, 1965, and 1970. During 1960, there were an estimated 1,024,000 saltwater anglers in the South Atlantic region (Clark 1961). The estimated number for 1965 was 1,720,000 (Deuel and Clark 1968) and for 1970 was 1,808,000 (Deuel 1973).

4. Economic Importance of Marine Recreational Fishing

The economic importance of the marine recreational fisheries to the States of South Carolina and Georgia is considerable. While these fisheries represent recreational activities at the individual angler level, they also form the basis of an economically significant industry. Expenditures by marine recreational anglers, both direct and indirect, such as those for fishing tackle, bait, food, lodging, transportation, charter fees, and associated equipment, are extremely important to the economic well being of coastal communities. In the South Atlantic region (Cape Hatteras to South Florida), the total estimated economic impact of marine recreational fishing during 1975 was approximately $458 million (Table 7-36).

A limited number of surveys and studies have been conducted which have focused on the economic impacts of various segments of the marine recreational fisheries of South Carolina. Several similar surveys have recently been initiated in Georgia. The results of these studies are

Table 7-31. Projected harvest by month for the six dominant genera of finfish caught by South Carolina pier anglers during 1974 (Hammond and Cupka 1977).

SPECIES	MONTHS								
	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	TOTAL
	NUMBER OF INDIVIDUALS CAUGHT								
SPOT	41,687	14,697	25,450	66,027	12,866	11,616	126,350	33,513	332,206
ATLANTIC CROAKER	58,832	29,976	23,953	84,926	29,101	7,746	2,761	9,202	246,497
KINGFISHES	24,826	19,793	8,010	22,009	14,857	9,484	27,781	24,201	150,961
FLORIDA POMPANO	-	-	175	5,705	13,940	12,295	6,349	1,099	39,563
SILVER PERCH	26,888	2,170	524	984	153	97	2,402	3,288	36,506
BLUEFISH	4,031	5,008	4,583	11,083	2,911	678	678	6,941	35,913

Table 7-32. Total estimated recreational harvest of finfish from Georgia waters during 1970 by area and by species (Morrow 1972).

	HARVEST IN THOUSANDS OF POUNDS		
Species	Oceanic	Estuarine	Total
Spotted seatrout	179	51	230
Spanish mackerel	160	---	160
King mackerel	50	---	50
Red drum	160	43	203
Atlantic croaker	565	33	598
Black drum	35	43	78
Sheepshead	35	58	93
Kingfishes	130	103	233
Flounders	64	36	100
Tarpon	19	12	31
Greater amberjack	35	---	35
Black sea bass	3	---	3
Cobia	15	---	15
Bluefish	15	---	15
Spot	69	139	208
Snappers	3	---	3
Sharks	75	18	93
Spadefish	14	18	32
Groupers	15	---	15
Mullets	17	10	27
Striped bass	---	23	23
TOTAL	1,658	587	2,245

1 lb = 0.45359 kg.

summarized and discussed in the following paragraphs.

Bearden (1969) estimated that during 1968, saltwater anglers participating in the South Carolina charter and head boat fisheries spent $2.4 million, of which $890,000 was on trip fees alone.

During 1972, a survey involving the Paradise Artificial Reef was conducted by the National Marine Fisheries Service (Buchanan 1973). This survey demonstrated that the reef attracted anglers and had a positive effect upon the economy of the Murrells Inlet-Myrtle Beach area. Nearly 16% of the private boat anglers active in the ocean sport fishery during the summer were attracted to this area because of the reef. The money spent by these additional anglers amounted to nearly 10% of the money spent in the area by all ocean fishermen.

A survey of the South Carolina pier fishery (Hammond and Cupka 1977) indicated that during 1974, pier anglers injected $2.4 million directly into the local business economy. Of this amount, $1.3 million can be directly attributed to the presence of the pier fishing industry.

Liao and Cupka (1979) surveyed the offshore fisheries of South Carolina during 1977. During this period, the estimated total annual expenditures by charter boat anglers was $1.5 million, while that of head boat anglers was $3.6 million (Table 7-37). In addition, private boat anglers were estimated to have had total direct expenditures of $17.3 million (Table 7-37).

Another aspect of the Liao and Cupka (1979) study was to determine the economic impact of South Carolina's artificial fishing reefs. Table 7-37 indicates that offshore fishing over the artificial reefs accounted for an estimated $4.94 million in total direct expenditures during 1977. Nonartificial reef fishing accounted for $17.36 million, for a total direct expenditure by offshore anglers of $22.3 million. This figure does not take into account expenditures by SCUBA divers or by nonresident private boat anglers.

Liao and Cupka (1979) also estimated the total economic impact of South Carolina's offshore anglers by using appropriate economic "multipliers" (Table 7-38). For artificial reef fishing, the total economic impact was

Table 7-33. The recreational and commercial harvests (in thousands of pounds) of selected species of saltwater fish for the South Atlantic region (Cape Hatteras to south Florida) during 1970 (Deuel 1973, Wheeland 1973).

SPECIES GROUP	RECREATIONAL CATCH (thousand pounds)	DOMESTIC COMMERCIAL CATCH (thousand pounds)
Spotted seatrout	25,063	3,872
Black drum	12,123	144
Kingfishes	14,533	2,095
Red drum	13,358	157
Spot	9,840	3,304
Atlantic croaker	5,947	886
Flounders	8,938	3,397
Pompanos	153	248
Cobia	775	21
Bluefish	19,271	2,551
Spadefish	51	2
Spanish mackerel	14,623	3,639
King mackerel	34,942	4,351
Dolphin	27,806	21
Sharks	669	10
Snappers	26,580	1,090
Porgies	24,059	799
Grunts	25,962	51
Groupers	24,121	754
Black sea bass	12,381	2,024
TOTAL	301,195	29,416
Grand total (includes all finfish species harvested, not just sportfish cited above.	403,913	209,350

1 lb = 0.45359 kg.

estimated to be $10.1 million. This means that re-spending of money spent by anglers who fished over the reef habitats generated an output of $5.1 million of goods and services in addition to the $4.9 million sold directly to the reef anglers. For offshore fishing at other than the reef locations, the total economic impact was estimated to be $37 million. Combining the estimated economic impacts of the reef and nonreef fishing results in a total estimated economic impact of $47 million to the State of South Carolina.

A similar survey of offshore fishing and its economic impacts is currently being conducted in Georgia (C. D. Harris, 1978, Georgia Department of Natural Resources, Brunswick, pers. comm.). It is anticipated that the results of the survey will be available in the near future.

An estimate of the total economic activity associated with the marine recreational finfish fisheries of South Carolina and Georgia can be obtained by examining the latest data available on numbers of participants in each State and on the average annual expenditure by saltwater anglers. During 1974, there were an estimated 396,000 participants in marine recreational finfishing in South Carolina and 557,000 participants in Georgia (Table 7-34). According to the 1975 National Survey of Hunting, Fishing and Wildlife Associated Recreation (U.S. Department of Interior, Fish and Wildlife Service 1977a), the average annual expenditure by saltwater anglers in 1975 was $210. If this figure is applied to the estimated number of marine finfish anglers in South Carolina and Georgia in 1974 an estimated economic impact of $83 million and $117 million for each State, respectively, is generated. These figures do not take into account nonresident anglers or other segments of the marine recreational fisheries.

B. FRESHWATER RECREATIONAL FISHERIES RESOURCES

Eleven watersheds, including 21 major river systems, one 60,400 acre (24,444 ha) lake and over 2,800 small

Table 7-34. Resident participation in various segments of the South Carolina and Georgia marine recreational fisheries.

Segment	Number of Resident Participants	Number of Fishing Days	Year Survey Was Conducted	Survey Source
South Carolina				
Surf and bank fishing	41,600	----	1968	Bearden (1969)
Small boat fishing	121,000	----	1968	Bearden (1969)
Pier fishing	30,000 a	200,000	1968	Bearden (1969)
Pier fishing	25,000 a	228,000	1974	Hammond and Cupka (1977)
Offshore trawling	26,000	----	1968	Bearden (1969)
Offshore bottom fishing	20,000	----	1968	Bearden (1969)
Total finfishing	174,000	----	1968	Bearden (1969)
Total offshore private boat fishing	14,305 b	225,981 c	1973	Bromberg (1973)
Total inshore private boat fishing	19,507 b	339,885 c	1973	Bromberg (1973)
Recreational shrimping	16,780	115,117	1974	S. C. Marine Resources Division, Charleston, unpubl. data
Total finfishing	396,000	2,572,000	1974	U.S. Department of Commerce, NOAA (1977b)
Total shellfishing	283,000	1,117,000	1974	U.S. Department of Commerce, NOAA (1977b)
Private boats - artificial reef fishing	3,947 d	33,550 e	1977	Liao and Cupka (1979)
Private boats - offshore (non-artificial reef fishing)	3,526 d	93,549 e	1977	Liao and Cupka (1979)
Georgia				
Total finfishing	170,000	1,024,000	1961	Power (1963)
Total inshore private boat fishing	27,968 b	487,306 c	1973	Bromberg (1973)
Total offshore private boat fishing	20,510 b	324,004 c	1973	Bromberg (1973)
Total finfishing	557,000	3,366,000	1974	U.S. Department of Commerce, NOAA (1977b)
Total shellfishing	251,000	1,202,000	1974	U.S. Department of Commerce, NOAA (1977b)

a. Number includes residents and nonresidents.
b. In terms of number of boats.
c. In terms of number of boat days.
d. In terms of number of boats measuring over 16 ft (4.9 m) in length.
e. In terms of number of boat days, boats measuring over 16 ft (4.9 m) in length.

Table 7-35. Estimated number of nonresidents participating in the marine recreational fisheries (finfishing and shellfishing) of South Carolina and Georgia, by State of residence, in 1973-74 (U.S. Department of Commerce, NOAA 1975, 1977b).

	NUMBER OF PARTICIPANTS	
State of Residence	South Carolina	Georgia
Alabama	2,000	9,000
Connecticut	2,000	
Delaware	3,000	
Florida	8,000	20,000
Georgia	105,000	
Louisiana		9,000
Maryland	13,000	8,000
Massachusetts	6,000	2,000
Mississippi	3,000	(a)
New Jersey	8,000	8,000
New York	27,000	12,000
North Carolina	350,000	3,000
Pennsylvania	19,000	75,000
Rhode Island		1,000
South Carolina		8,000
Texas	5,000	6,000
Vermont	1,000	2,000
Virginia	84,000	6,000
TOTAL	658,000	170,000

a. Less than 500 participants estimated.

lakes and farm ponds, form the basis for the freshwater fishery resource of the Sea Island Coastal Region. However, this represents only a small percentage of the freshwater fishery resource of both States. South Carolina has over 30 river systems, 8 main reservoirs comprising a total of 400,000 acres (161,878 ha), approximately 1,400 lakes in excess of 10 acres (4.1 ha) in surface area amounting to some 492,000 acres (199,110 ha) of impounded water, and an additional 25,000 plus farm ponds scattered throughout its 46 counties (Coleman and Dennis 1974). Georgia has more than 25 river systems, 27 reservoirs in excess of 500 acres (202 ha) in size totaling 261,675 acres (105,898 ha) in surface area, and over 60,000 ponds accounting for an additional 250,000 acres (101,174 ha) of fishery habitat (Georgia Game and Fish Commission 1971a-g). Thus, it is evident that the study area represents only a fraction of the total freshwater fishing resources of both States.

Freshwater fishing in the coastal area offers a unique type of fishing. Elements of the natural environment, water quality, natural beauty, and privacy while fishing were consistently noted as the most important factors influencing fishing enjoyment by New York State anglers surveyed to determine what fishermen look for in a fishing experience (Moeller and Engelken 1972). Size and number of fish caught, weather conditions, and ease of access to fishing waters were rated of moderate importance. Facilities available were rated as low importance. Interviewed Georgia anglers indicated that easy driving distance, good access to the water, adequate facilities, size and number of fish, few other fishermen, less pleasure boating, and scenic beauty were important factors accounting for their being attracted to a fishing area (Environmental Research Group 1971).

A survey of wildlife recreation in South Carolina disclosed that 52% of all households interviewed contained members who had fished during the previous year (Environmental Research Group 1974). Of the 734,400 households in South Carolina, an estimated 381,123 households had at least one member who fished during 1971. During 1971, an estimated 310,839 South Carolina households valued 12.8 million fishing days at $281.9 million. Of those freshwater anglers indicating a preference for fishing location, 24.7% preferred natural streams and rivers, 23.9% preferred lakes in excess of 5 acres (2 ha) in size and 20.7% would rather fish in small ponds of less than 5 acres (2 ha) (Environmental Research Group 1974). According to this same survey, 21.5% of the fishing trips by individuals who fished in streams and rivers were directed

Table 7-36. Economic impacts (thousands of dollars) of marine recreational fishing in the South Atlantic region (Cape Hatteras to south Florida) during 1975 (Centaur Management Consultants, Inc. 1977).

	SALES	WAGES	SALARIES	EMPLOYMENT (person-years)	ANNUAL CAPITAL EXPENDITURES
Fishing Tackle					
Manufacturing	9,890	6,260	2,720	430	430
Wholesale Trade	11,100	1,040	820	90	70
Retail Trade	23,600	9,020	2,740	400	680
Boats					
Manufacturing	14,150	6,210	3,000	420	170
Retail Trade	21,170	3,360	1,590	210	120
Motors					
Manufacturing	5,060	2,300	860	60	150
Retail Trade	6,890	1,070	520	70	50
Trailers					
Manufacturing	1,530	710	260	30	50
Retail Trade	1,830	310	140	20	10
Marinas	24,430	9,770	6,600	660	490
Commercial Sport-fishing vessels	22,260	13,320	6,460	890	1,550
Boat Fuel					
Manufacturing	4,990	810	90	10	220
Wholesale Trade	7,430	710	150	20	110
Retail Trade	8,750	1,430	500	110	70
Food	46,780	16,860	10,760	2,270	1,270
Lodging	10,950	5,740	2,900	600	300
Travel					
Manufacturing	24,800	4,290	580	40	1,100
Wholesale Trade	36,930	3,540	900	90	560
Retail Trade	43,450	5,040	3,170	560	350
Boat Insurance	5,700	1,320	500	40	
Bait	42,770	8,510	3,500	530	260
Other	30,330	6,070	3,640	540	610
TOTAL	288,910	107,690	52,400	8,090	8,820

toward sunfish and perch fishing, 19.1% were for catfish, 12.4% were for trout, and 12.0% were for crappie. Anglers fishing in reservoirs, lakes, and ponds concentrated largely on bass (25.5%), sunfish and perch (18.0%), crappies (15.9%), and mixed creel (11.7%).

A 1970 survey of Georgia anglers indicated that 24.8% preferred to fish in warm-water streams, 15.2% preferred to fish in other freshwater areas (reservoirs, lakes, and ponds) and 26.5% indicated a preference for saltwater fishing (Environmental Research Group

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Table 7-37. Total direct economic impact of anglers by types of fishing activities in 1977 off South Carolina (Liao and Cupka 1979).

ITEM	ARTIFICIAL REEF FISHING	NON-ARTIFICIAL REEF FISHING	TOTAL
Private boat anglers' expenses for boating and fishing equipment	$2,227,419	$ 5,677,740	$ 7,955,159
Private boat anglers' trip expenses	2,243,790	7,067,649	9,311,440
Head boat anglers' trip expenses	254,436	3,306,778	3,561,214
Charter boat anglers' trip expense	160,429	1,306,274	1,466,703
TOTAL	$4,936,075	$17,358,442	$22,294,516

Table 7-38. Total economic impact of all offshore anglers' expenditure by types of fishing activities in 1977 off South Carolina (Liao and Cupka 1979).

ITEM	ARTIFICIAL REEF FISHING	NON-ARTIFICIAL REEF FISHING	TOTAL
Private boat anglers' expenses for boating and fishing equipment	$4,486,515	$11,185,147	$15,671,663
Private boat anglers' trip expenses	4,599,770	15,124,770	19,724,540
Head boat anglers' trip expenses	582,658	7,638,659	8,221,317
Charter boat anglers' trip expenses	373,800	3,043,618	3,417,419
TOTAL	$10,042,745	$36,992,195	$47,034,941

1971). Fish species in order of preference were largemouth bass, catfish, and crappie. Georgia coastal counties accounted for over 37% of all reported freshwater fishing trips on a statewide basis. The county percentages are as follows: Glynn - 13.6%; Camden - 9.6%; Liberty - 7.2%; Bryan - 4.8%; McIntosh - 2.4%; Chatham - 0.0%; and Effingham - 0.0%.

Of the over 110 freshwater fish species occuring in the coastal area of South Carolina and Georgia, 17 fish represent the primary target species of freshwater sport fishermen (Table 7-39). Other species such as the American eel, bowfin, redfin pickerel, yellow and brown bullheads, and carp may also be fished for by certain anglers and eaten by fishermen who catch them incidental to the more desirable species. Numerous additional fish species are important as forage (food) for the larger gamefish. Such fish as bluegill, golden shiner, gizzard and threadfin shad, killifishes, mosquitofish, and the various suckers and shiners are typical forage found throughout the fresh waters of the coastal area.

Although little documented information is available concerning the quality or quantity of sportfishing or even the delineation of the freshwater resources of the coastal area of South Carolina and Georgia, several articles and brochures (e.g., South Carolina Wildlife and Marine

Table 7-39. Primary target species of South Carolina and Georgia freshwater sport fishermen.

COMMON NAMES
American shad
Black crappie
Bluegill
Chain pickerel
Channel catfish
Largemouth bass
Redear sunfish
Redbreast sunfish
Smallmouth bass
Striped bass
Striped bass/white bass hybrid
Walleye
Warmouth
White bass
White catfish
White crappie
Yellow perch

Resources Department 1969, 1975a; Georgia State Game and Fish 1970; Georgia Department of Community Development 1975) provide a general description of freshwater fishing in the coastal area. The following describes and presents the available information on freshwater fishing resources of the coastal area of both States and summarizes estimates of the fishing pressure and harvest by freshwater anglers within this area.

1. Major Types of Activities

Other than Lake Moultrie, which borders the characterization area, little or no information is available concerning impoundments in the coastal area. The number of impoundments in the various Georgia coastal counties has not been documented and is not available in published form at this time. The best available information concerning the number of impoundments for both South Carolina and Georgia indicates a wide discrepancy between the two States with South Carolina coastal counties reported to contain 2,359 impoundments compared to 445 for Georgia coastal counties (Table 7-40). Similarly, for lakes in excess of 10 acres (4 ha) in surface area, South Carolina has a reported 235 impoundments comprising 182,866 acres (74,005 ha) compared to 68 such impoundments totaling 3,953 acres (1,560 ha) in Georgia coastal counties.

Of the 14 South Carolina and eight Georgia State-maintained freshwater fishing areas, only two occur within the coastal region. A 4-acre (1.6 ha) managed pond exists in the Francis Marion Game Management Area in Charleston County, South Carolina. Three lakes in the Champany Island area, totalling in excess of 100 acres (40.5 ha), are located 2 mi (3.2 km) south of Darien, Georgia, on Highway 17 (Georgia Department of Natural Resources 1976a). These latter lakes are stocked with bass, bream, and catfish and receive wild fish from the Champany River. Several non-managed smaller impoundments offering excellent fishing, however, occur within State and Federal lands, such as the freshwater ponds in the Cape Romain National Wildlife Refuge on Bull Island, South Carolina.

The majority of impoundments within the coastal area of both States are farm ponds and "borrow pits" which result from highway construction. The Georgia Highway Department estimates that between 75 and 200 acres (30.4 - 80.9 ha) of "borrow pits" have been created for each 10 mi (16.1 km) of Interstate Highway constructed in Georgia. Since a sandy type of soil is required for highway construction, which primarily is found between naturally occurring ridges, these "borrow pits" typically have a drainage system similar to a naturally occurring pond. Thus, species composition, through invasion of wild or naturally occurring fish species into these "borrow pits," is similar to that typically encountered in natural impoundments. Fish species typically found in freshwater impoundments within the study area are presented in Table 7-41.

Bluegill, redear sunfish, largemouth bass, and channel catfish represent the most desirable farm pond or small impoundment fish community (Georgia Department of

Table 7-40. Inventory of lakes and ponds in South Carolina and Georgia Sea Island Coastal Region (Morrow 1972, Coleman and Dennis 1974).

COUNTIES	ESTIMATED TOTAL NUMBER OF PONDS AND LAKES	ESTIMATED NUMBER OF PONDS AND LAKES OVER 10 ACRES	ESTIMATED SURFACE ACRES OF LAKES AND PONDS OVER 10 ACRES[a]
SOUTH CAROLINA			
Georgetown	597	14	277
Charleston	378	78	4,800
Berkeley	320	44	174,650
Dorchester	355	10	388
Colleton	436	32	2,547
Beaufort	142	30	1,452
Jasper	131	27	752
GEORGIA			
Effingham	160	10	390
Chatham	143	34	740
Bryan	18	4	124
Liberty	57	7	1,445
McIntosh	21	8	1,095
Glynn	28	4	149
Camden	18	1	10

a. 1 acre = 0.4047 ha

Natural Resources 1977a) and are the species stocked by South Carolina and Georgia resource agencies in their farm pond programs. Both States have extensive hatchery programs for rearing striped bass, which are stocked in larger impoundments such as Lake Moultrie.

Lake Moultrie is the only "large" impoundment within the study area. Lake Moultrie's 60,400 acres (24,444 ha) are easily accessible by State and county roads. This lake is joined to Lake Marion by a 7.5 mi (12.1 km) diversion canal and both reservoirs have a total of 450 mi (724 km) of shoreline. Numerous motels and fishing camps offer accommodations, services (including guides), and supplies. One State park, 43 camping areas, and 49 boat landing ramps are conveniently situated around both lakes.

Lakes Marion and Moultrie are famous for their land-locked striped bass populations. Because of their abundance, striped bass provide excellent angling throughout most of the year, but the spring spawning period is considered the best fishing season. Summer is also an excellent time to fish for striped bass. During this time, striped bass as well as white bass begin grouping in sizable numbers to feed on schooling baitfish.

Largemouth bass fishing in lakes Marion and Moultrie offer fishing opportunities all year. In the spring, largemouth bass begin moving into shallow water to spawn. Fishing for them is best during this period and immediately after spawning. In the summer, largemouth bass, striped bass, and white bass are found congregating in deep holes to escape the summer heat. During cooler periods of the summer, largemouth are taken in flooded timber, submerged brush piles, around stumps, and below the spillway. Crappie will also be found in these areas and good catches of both species are common. Crappie fishing is best in the spring and fall around submerged debris. Most are caught in relatively shallow water, usually not exceeding 4.6 m (15 ft) even during the hottest or coldest weather.

Areas where bass and crappie may be caught vary greatly depending on weather and water conditions, but a few often-mentioned places are upper Lake Marion near Renine, Wybow, and Jack's creeks. The Congaree, Cooper, Wateree, and Santee rivers and the Santee-Cooper Diversion Canal are productive especially in the spring when striped bass spawning activity is greatest. Bream fishing offers year-round opportunity, but is best when these fish are bedding in shallow water during late spring and early summer. Catfish and jack (chain pickerel) angling is good but unpredictable in these lakes.

Table 7-41. Fish species typical of coastal freshwater impoundments (C. S. Hall, 1978, Georgia Department of Natural Resources, Richmond Hill, pers. comm.).

FISH SPECIES TYPICAL OF COASTAL AREA FRESHWATER IMPOUNDMENTS	FISH SPECIES TYPICAL OF IMPOUNDMENTS IN OR NEAR BRACKISH WATER
Bluegill	American eel
Redear sunfish	Sailfin molly
Largemouth bass	Killifishes
Channel catfish	Striped mullet
Lake chubsucker	Gizzard shad
Black crappie	Atlantic croaker
Mosquitofish	Southern flounder
Brown bullhead	White catfish
Yellow bullhead	
Warmouth	
Chain pickerel	
Golden shiner	

The 21 major river systems within the Sea Island characterization area offer year-round fishing opportunities. Fishing occurs from boats, banks, and private piers. Access in highly populated areas is usually good, with public boat landings for small boats and public lands providing access for bank fishermen. However, the majority of these rivers flow through rural and sparsely populated areas where access is limited. These rivers, which flow across the sandy lower coastal plain of the study area before emptying into the Atlantic Ocean, are not heavily loaded with silt and receive little industrial pollution. With the exception of a few of the larger rivers, such as the muddy Altamaha River with its tributaries from the agricultural red clay belt, the waters of these rivers are relatively clean and clear throughout most of the year.

Largemouth bass and redbreast sunfish are the most sought after of all riverine fish by sportfishermen. Both fish may be caught throughout the year and provide excellent fishing within each river system. Large populations of crappie, bluegill, yellow and white perch, chain pickerel, warmouth, bowfin (mudfish), and catfish (white, blue, channel, and bullhead) also occur within each river system and provide excellent fishing opportunities. Rock outcroppings, rapids, and feeder streams are areas typically providing excellent fishing. Swamps, dead lakes or oxbows, rice field brakes, and natural impoundments occur along many of these river systems and are primary fishing locations.

Striped bass and American shad migrate up many of these rivers annually to spawn in the early spring. Thousands of these fish are caught each year by anglers trolling from boats or casting from the bank. This type of fishing is best in rivers with clear clean waters, such as the Ogeechee, and poor in muddy rivers, such as the Altamaha.

2. Recreational Harvest of Freshwater Species

Little information is available concerning the fishing pressure and harvest of freshwater fishes in the coastal area of South Carolina and Georgia. A single creel census (May and Williams 1966), with no estimate of fishing pressure, is available for South Carolina rivers, and only three surveys (Holder and Smith 1972, Georgia Department of Natural Resources 1974, 1976b) are available for Georgia rivers within or near the Sea Island Coastal Region. There is a similar lack of information concerning fishing pressure and harvest of fishes in impoundments, with a single 1-year survey being available on the only major reservoir (Lake Moultrie) in the study area. Although little information is available on the numerous ponds and other small impoundments throughout the coastal area of these States, their importance is stressed in the Georgia Department of Natural Resources (1977a) publication entitled "Management of Georgia Fish Ponds," which states: "Fish ponds are a valuable fishery resource in Georgia. Approximately 40 percent of the fishing pressure exerted by Georgians is currently placed on the 60,000 ponds distributed across the State. These 250,000 acres of fishery habitat are important in reducing pressure on public waters and in providing many state residents with local fishing opportunities."

Some indication of the fishing pressure received by freshwater areas is indicated by the number of freshwater fishing licenses sold in the various coastal counties. Totals of 40,603 and 41,974 freshwater fishing licenses or combination fishing and hunting licenses were sold during 1976 in South Carolina and Georgia coastal counties, respectively (Table 7-42). An additional 21,937 short-term or nonresident licenses were sold in South Carolina during 1976. Although this information is not available for Georgia, if it is assumed that a similar percentage of nonresident and short-term licenses are sold in both States, an estimated 23,000 such licenses would have been sold in Georgia in 1976. Thus, an estimated total of 126,863 freshwater fishing licenses would have been sold in the coastal counties of both States during 1976. This of course represents only a small percentage of the number of individuals who actually fished within this area. Anglers normally buy their annual fishing license in their county of residence; thus, residents of non-coastal counties coming into the coastal counties to fish probably would have already purchased valid fishing licenses.

An indication of the number of anglers coming into the coastal area to fish is evidenced by the fact that within the Francis Marion National Forest, located in the central portion of the South Carolina coastal area, there were 193,700 visitor days of recreational use during 1975 (U.S. Department of Agriculture, Forest Service 1977). Of this total, an estimated 15.5% or 30,023 visitor days were directed toward fishing.

Even less information is available concerning the number or pounds of freshwater fish harvested by anglers in the coastal area. The Georgia Wildlife and Resources Inventory (Morrow 1972) presents estimates of the annual harvest of freshwater fish by anglers within Georgia's coastal counties. These estimates give an indication of the relative importance of the various freshwater game fish (Table 7-43). An estimated 1,017,430 lb (461,496 kg) of fish are taken annually in Georgia by freshwater anglers. Bluegill, largemouth bass, striped bass, spotted sucker, and channel catfish make up over 50% of the total weight of all fish harvested annually.

During the period 1 July 1965 through 30 June 1966, the South Carolina Wildlife and Marine Resources Department conducted a creel census to determine the major recreational fish species and angling success within several of South Carolina's coastal streams (May and Williams 1966). No attempt was made to determine the number of anglers or the fishing pressure exerted on these streams. Sportfishing surveys within the Altamaha River during the summer months and annual surveys of the Ogeechee River and the Satilla River have been conducted by the Georgia Department of Natural Resources. The Satilla River survey was carried out just above the ecological characterization study area, but, as this study represents the only information concerning angling pressure on this river, it has been included here. Species composition and angling pressure should be similar to the lower freshwater portions of this river.

The following summarizes the major points and findings of the available and pertinent sport fishing surveys conducted within or near the coastal fresh waters of South Carolina and Georgia.

a. Rivers and Streams

(1) Little Pee Dee River. Between April and July 1966, 280 anglers were checked. These fishermen had fished 737 hours catching 2,899 fish or 3.9 fish per hour. The major species caught were bream (bluegill, redbreast sunfish, and warmouth) 77%, catfish 13.2%, bowfin 3.8%, largemouth bass 1.8%, and crappie 1.8% (May and Williams 1966).

(2) Black River. The 712 anglers interviewed between April and July 1966 had fished 1,342 hours catching 5,435 fish or 4.0 fish per hour. The major species caught were bream 66.9%, catfish 12.6%, yellow perch 9.4%, crappie 5.2%, largemouth bass 3.0%, bowfin 1.5%, and pickerel 1.3% (May and Williams 1966).

(3) Waccamaw River. A total of 5,435 fish were taken by 894 anglers checked between April and July 1966. They had fished a total of 5,705 hours for an average catch of 1.0 fish per hour. The major species caught were bream 57.9%, yellow perch 29.0%, crappie 6.2%, largemouth bass 3.5%, catfish 1.5%, and pickerel 1.4% (May and Williams 1966).

(4) Lynches River. A total of 2,127 fish were caught by the 465 anglers checked between April and July 1966. These anglers fished a total of 910 hours for an average catch of 2.3 fish per hour. The major fish species taken were bream 71.8%, yellow perch 10.5%, catfish 8.4%, pickerel 4.0%, bowfin 3.8%, crappie 0.9%, and largemouth bass 0.7% (May and Williams 1966).

(5) Altamaha River. A 107-mi (172.2 km) segment of the Altamaha River was surveyed for sportfishing pressure and harvest during July and August, 1972 (Holder and Smith 1972). During this 8-week period, an estimated 83,469 angling hours were expended and an estimated 158,591 fish weighing 54,886 lb (24,896 kg) were harvested. Channel

Table 7-42. Number of freshwater fishing licenses sold in the coastal counties of South Carolina and Georgia during 1976 (L. Amick, 1978, South Carolina Wildlife and Marine Resources Department, Columbia, pers. comm.; C. S. Hall, 1978, Georgia Department of Natural Resources, Richmond Hill, pers. comm.).

South Carolina (1976)	Combination Hunting & Fishing	State Fishing (Annual)	State Fishing (14 days)	Lake & Reservoir Permits	Nonresident Fishing (Annual)	Nonresident Fishing (10 days)	Total
Georgetown	1,916	980	76	9	27	169	3,177
Berkeley	3,322	11,900	2,052	4,838	1,009	8,177	31,298
Dorchester	1,608	2,338	212	212	21	187	4,578
Charleston	4,183	7,906	802	781	38	501	14,211
Colleton	1,627	2,080	293	---	54	193	4,247
Beaufort	831	948	132	---	87	503	2,501
Jasper	561	403	64	---	139	163	1,330
TOTAL	14,048	26,555	3,631	5,840	2,475	9,893	62,442
Georgia (1976)							
Effingham	385	2,999	-----	-----	-----	-----	-----
Chatham	1,634	11,294	-----	-----	-----	-----	-----
Bryan	126	1,366	-----	-----	-----	-----	-----
Liberty	619	3,260	-----	-----	-----	-----	-----
McIntosh	85	580	-----	-----	-----	-----	-----
Glynn	462	3,912	-----	-----	-----	-----	-----
Camden	91	1,013					
TOTAL	17,450	24,424	-----	-----	-----	-----	41,874

Table 7-43. Estimated annual angling harvest of freshwater fish in the coastal counties of Georgia (Morrow 1972).

FISH SPECIES	HARVEST IN POUNDS[a]
Blue gill	156,000
Largemouth bass	141,000
Striped bass	89,910
Spotted sucker	85,500
Channel catfish	65,520
Chain pickerel	50,000
White catfish	46,000
Redbreast sunfish	42,500
Redear sunfish	41,500
Bullheads	41,000
Warmouth	36,000
Brown bullhead	33,500
Flat bullhead	32,500
Black crappie	31,000
Redfin pickerel	31,000
Other sunfish	26,000
American eel	24,500
Striped mullet	13,000
Carp	10,000
White crappie	8,500
Suckers	8,500
Freshwater drum	3,000
White bass	1,000

a. 1 lb = 0.45359 kg

catfish was the dominate fish caught comprising 52.7% by number and 47.2% by weight. Bluegill and redbreast sunfish accounted for 33.5% by number and 28.1% by weight of all fish caught. If one assumes an average fishing trip lasted 4 hours (see Satilla River survey), an estimated 20,867 fishing trips would have been made to this river during this 2-month period, and if these 2 months represent 20% of the annual trips to the Altamaha, a total of 104,335 angling trips during 1972 would be estimated (Holder and Smith 1972).

(6) Ogeechee River. During the period July 1972 through June 1973, 386 anglers were interviewed at one of 16 access points to the freshwater and estuarine portions of the Ogeechee River (Holder 1975). White catfish, bullheads, and redbreast sunfish were the most frequently caught fish. Expanded estimates of fishing pressure and harvest could not be calculated for this survey.

An expanded creel census was carried out from 25 August 1973 to 31 July 1974 on the Ogeechee River (Holder 1975). The river was divided into three areas, a lower estuarine section extending from River Mile 5.7 to River Mile 27.5 and containing an estimated 5,179 acres (2,096 ha) of water, a middle freshwater section extending from River Mile 27.5 to River Mile 60.5 and containing approximately 517 acres (209 ha) of water, and an upper river section extending from River Mile 60.5 to River Mile 125 with an estimated 1,029 acres (416 ha) of water. The middle section, which falls within the ecological characterization study area, received 48,520 angler hours (87.1/acre) of fishing that resulted in a catch of 38,178 fish (68.5/acre) weighing 22,735.2 lb (40.8/acre or 45.7 kg/ha). The overall catch rate in this section was 0.787 fish per hour. Largemouth bass, redbreast sunfish, bluegill, and bullheads were the principal species caught and made up 91% by number and 88.8% by weight of the total catch.

(7) Satilla River. A sportfishing survey of the Satilla River was conducted over a 4-year period, July 1971 through June 1975 (Georgia Department of Natural Resources 1976b). During the first 2 years, 140 mi (225.3 km) of the Satilla River (beginning in Ware County and ending in Charleston County) were surveyed. During the periods of July 1971 through June 1972 and July 1972 through June 1973, fishermen expended a total of 66,305 hours and 77,825 man-hours, respectively. Harvest figures during these

two periods differ greatly. A total of 130,820 fish were harvested during 1971-72 while only 77,688 fish were harvested during the 1972-73 survey. During 1971-72, 87.03 fish per acre were harvested that weighed 32.94 lb (14.9 kg), whereas during 1972-73, 39.83 fish weighing 17.8 lb (8.1 kg) (only half as many fish) were harvested per acre.

During both years, redbreast sunfish and bluegill were harvested in the greatest numbers. They comprised 25.74% of the total number of fish caught. Bullheads, channel catfish, and spotted sunfish were also harvested in high numbers. Channel catfish, redbreast sunfish, and bullheads collectively comprised 59.50% of the total weight of all fish harvested.

From 1 July 1973 to 30 June 1974 and from 6 July 1974 to 27 June 1975, the survey was carried out in two areas of the Satilla River (Georgia Department of Natural Resources 1976b). One area was the upper Satilla from Highway 64 to James Town Road Bridge, covering 37.6 river miles (60.5 km). The second area, from Robertson's Hammock to Highway 252, covered a distance of 50.1 river miles (80.6 km). The lower area, although still above the ecological characterization area, is quite similar to the study area, and results from that survey are presented here. An estimated 8,306 and 5,680 fishing trips were made, respectively, during the 2-year period. These trips represent 37,075 and 17,718 angler hours, respectively. Average trip length was 4.5 hours in the first year and 3.1 hours in the second year. The catch was estimated to be 22,369 fish weighing 11,752 lb (5,335 kg) in the first year and 16,873 fish weighing 11,295.2 lb (5,128 kg) in the second year. Mean catch rate for each period was 6.0 fish (0.32 lb/hr) during the first year and 0.95 fish (0.64 lb/hr) during the second year. Bullheads were the most abundant fish taken, comprising 27.9% and 38.9% by number during each year, respectively. Other species abundant both years were bluegill, largemouth bass, redbreast sunfish, and channel catfish.

b. Impoundments. As previously noted, information and estimates as to the fishing pressure and harvest of freshwater fishes in South Carolina and Georgia coastal impoundments other than for Lake Moultrie are not available.

An annual sportfishing survey has been conducted since 1970 on Lake Moultrie by the South Carolina Wildlife and Marine Resources Department. However, only the most recent report, concerning the 1972 survey, gives data specifically for Lake Moultrie (White 1974). During prior years, all data were combined for lakes Moultrie and Marion. A total of 177,317 fish weighing 260,830 lb (118,310 kg) were estimated to have been harvested from Lake Moultrie during 1972 (Table 7-44). Crappie, bluegill, striped bass, and largemouth bass were the most frequently caught fish, comprising 94.5% of the total catch. A total effort of 126.305 hours of fishing was estimated to have been expended on this 60,400 acre (24,444 ha) lake. If it is assumed that an average fishing trip is approximately 4 hours in duration (see Satilla River survey), a total of 31,576 angler trips would be estimated to have been made to this lake during 1972.

Table 7-44. Catch and effort fishery data from Lake Moultrie for the period 29 December 1971 through 29 December 1972 (White 1974).

Species	Total Harvest		Catch per hour		Average Weight (lb)	Harvest per Acre	
	Number	Weight (lb)[a]	Number	Weight (lb)		Number	Weight (lb)
Largemouth bass	18,129	55,548	0.143	0.440	3.06	0.30	0.92
Bluegill	44,879	21,188	0.355	0.167	0.47	0.74	0.35
Crappie	72,676	63,311	0.575	0.501	0.87	1.20	1.04
White bass	400	579	0.003	0.004	1.44	0.01	0.01
Striped bass	31,794	113,431	0.251	0.898	3.56	0.53	1.88
Catfish	5,872	5,311	0.046	0.042	0.90	0.09	0.08
Yellow perch	3,254	976	0.257	0.007	0.30	0.05	0.02
Chain pickerel	306	486	0.002	0.003	1.62	0.01	0.01
TOTALS	177,317	260,830	1.403	2.065	1.47	2.94	4.31

Total effort = 126,305 hours

[a] 1 lb = 0.45359 kg.

CHAPTER EIGHT

WILDLIFE CONSERVATION AND UTILIZATION

The purpose of this chapter is to provide a framework for understanding various factors which affect wildlife management and the relative importance of wildlife resources in the study area. In order to accomplish this, biological and economic information are presented as a unit. The reader will find some overlap between biological sketches in this chapter and information found in Volume III. However, this chapter not only presents biological species accounts, but also describes historical perspectives, habitat management procedures, resource utilization, and economic considerations.

I. WATERFOWL RESOURCES

The waterfowl resources of South Carolina and Georgia are dynamic and constitute an important component of the coastal ecosystem. Included are over 30 species of waterfowl and thousands of acres of several types of natural and managed habitats. An overview of the status, seasonal occurrence, and habitat preference of waterfowl that utilize the coastal areas of South Carolina and Georgia is given in Table 8-1. This is followed by a brief description (in phylogenetic order) of the most important species of waterfowl that utilize the study area. Subsequent sections discuss waterfowl habitats, management practices, population dynamics, and harvest characteristics.

A. WATERFOWL SPECIES ACCOUNTS

Wood duck - The wood duck is the only species of migratory waterfowl whose breeding range includes South Carolina and Georgia, as well as the entire Southeastern region. Because of its resident status, it is one of the most important species of waterfowl in the study area. Winter populations are estimated at 235,000 for South Carolina and 190,000 for Georgia (Bellrose 1976). During the 1972-73 waterfowl season, it was the number one species harvested in both states (Benning et al. 1975). Sutherland (1971) estimated the breeding population of wood ducks in South Carolina at 40,000 and in Georgia at 30,000.

Preferred breeding habitat for wood ducks consists of freshwater areas such as bottomland sloughs, slow moving rivers, and shallow ponds which are characteristic of many of the major drainages in the study area. This breeding habitat must contain suitable cover of shrubs and trees, adequate food resources which are high in protein, water levels which persist throughout incubation, and suitable brood rearing locations as well as the presence of usable nesting cavities (McGilvrey 1968).

Proper brood rearing habitat is composed of an interspersion of herbaceous aquatic plants, shrubs, and open water (75% cover and 25% open water). There should be an abundance of aquatic insects and water levels should remain fairly constant throughout the fledging period (Bellrose 1976). In the South, beaver impoundments provide excellent brood rearing habitat (Hepp and Hair 1977).

Favored winter habitats include secluded freshwater swamps and marshes (Johnsgard 1975). In the study area, wood duck numbers increase steadily from September through December due to the influx of northern migrants (Fig. 8-1). Spring migration begins in early February and continues into April in the Southeast region.

Landers et al. (1977) demonstrated the importance of habitat diversity for meeting the year-round nutritional requirements of wood ducks. They noted the importance of animal matter in the diet during the spring which supports other results indicating the importance of invertebrates to breeding waterfowl. Fleshy fruits (e.g., blackberry and black cherry) are important in the summer. Acorns are important fall and winter food when they are abundant, but Asiatic dayflower is the food taken most consistently during late fall and winter. Bellrose (1976) indicated that acorns are the favored food of wood ducks in more places than any other food. McGilvrey (1966a) reported that fruits from oaks, bald cypress, sweet gum, and water hickory are important foods of wood ducks in South Carolina.

American wigeon - Along the Atlantic coast, wigeon winter in fresh and brackish areas from Long Island southward, particularly in Maryland, South Carolina, and Florida (Johnsgard 1975). The marshes of South Carolina overwinter almost 60,000 wigeon, the largest concentration in the Atlantic flyway (Bellrose 1976). In coastal areas, the preferred foods of wigeon include eel grass, widgeongrass, pondweed, and Chara spp. (muskgrass). Wigeon prefer the stems and leafy portions of these aquatic plants.

In managed tidal impoundments of South Carolina, Landers et al. (1976) reported that widgeon grass and red root were the most important components of the wigeon's diet. McGilvrey (1966a), in a food habits study on Lake Marion, South Carolina (an inland reservoir of great importance to wintering waterfowl), demonstrated that rice cutgrass, spikerush, and water grass were the plant foods of most importance to wigeon. Kerwin and Webb (1972) demonstrated the importance of southern naiad and widgeongrass in the diet of this species.

Table 8-1. Status, seasonal occurrence, and habitat preferences of waterfowl reported for the coastal region of South Carolina and Georgia (adapted from Johnson et al. 1974).

Common Name	Status SC	Status GA	Seasonal Occurrence: Permanent Resident	Summer Resident	Winter Resident	Uncertain	Preferred Habitat: Offshore	Beaches, Dunes, Mud Flats	Forests	Fields, Pastures	Freshwater Marshes, Ponds	Salt Marshes	Estuaries, Sounds
Whistling swan	T	T			X								X
Canada goose	FC	FC			X					X	X		
	loc.	loc.		X									
Brant	T	T			X								X
Snow goose	T	T									X		X
Blue goose	T	T			X			X					
Fulvous tree duck	T	T			X			X					
Mallard	C	FC			X						X		X
		loc.		X									
Black duck	C	FC			X						X		X
Mottled duck	T	T		X						X	X		
Gadwall	C	C			X						X		X
Pintail	C	FC			X						X		
Green-winged teal	C	C			X						X		X
Blue-winged teal	FC	FC			X						X		X
European wigeon	T	T			X								
American wigeon	C	FC			X						X		
Shoveler	FC	FC			X						X		
Wood duck	C	C	X								X		
Redhead	UNC	UNC			X								X
Ring-necked duck	C	FC									X		X
		C			X								
Canvasback	FC	FC			X								X
Greater scaup	T	T			X								X
		loc.											
Lesser scaup	C	C			X						X		X
Common goldeneye	UNC	UNC			X								X
Bufflehead	UNC	C			X								X
Oldsquaw	UNC	C			X								X
King eider	T	T			X								X
White-winged scoter	T	T			X		X						X
Surf scoter	UNC	UNC			X		X						X
Common scoter	C	C			X		X						X
		loc.											
Ruddy duck	FC	FC			X						X		X
Hooded merganser	UNC		X										X
		C			X								
Common merganser	UNC	UNC			X						X		X
Red-breasted merganser	UNC	C			X						X		X

C - common; FC - fairly common (30-70%); UNC - uncommon (less than 30%);
T - transient; loc. - locally.

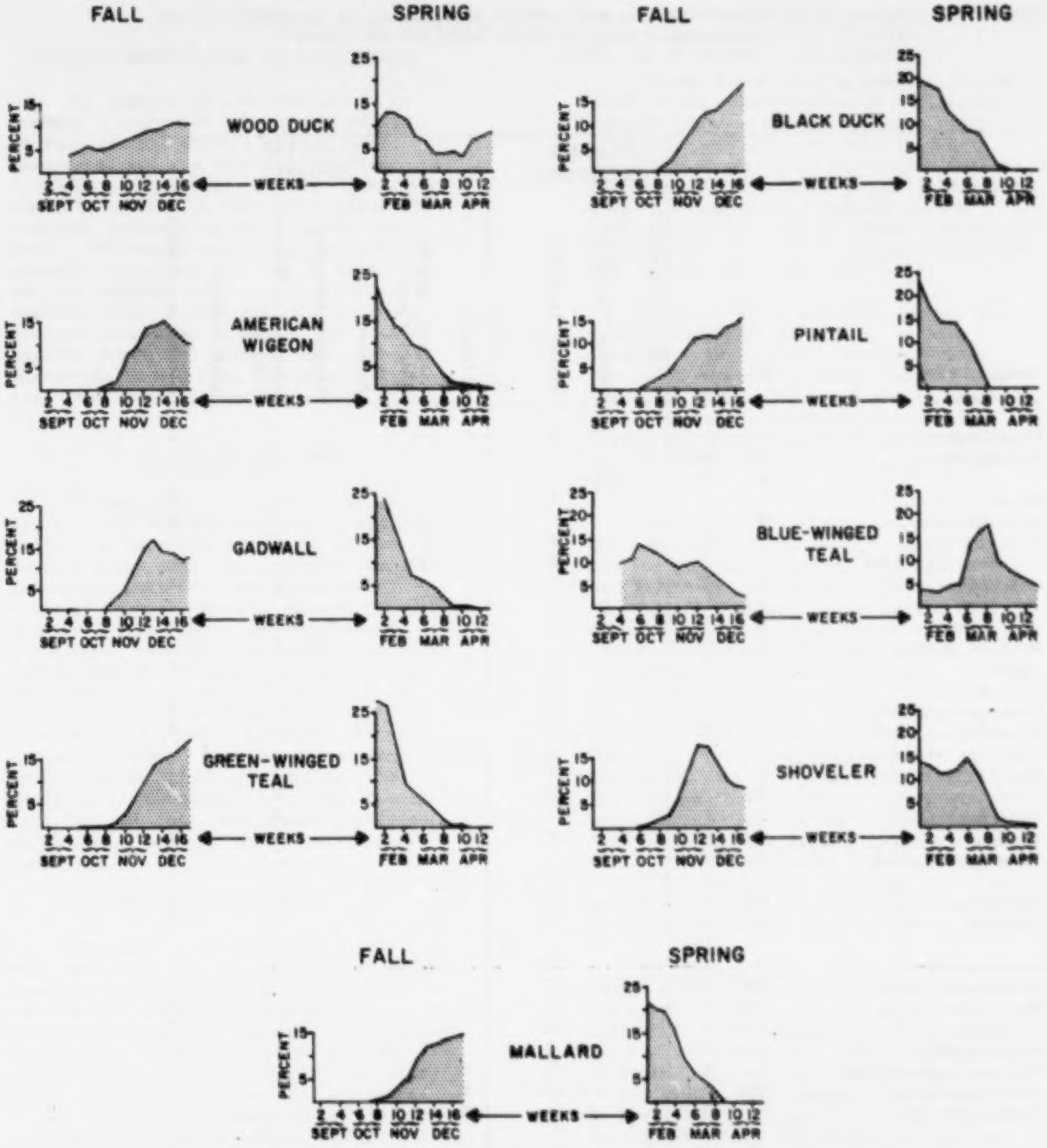

Figure 8-1. The chronology of dabbling duck migration on the Southeastern coast during the fall and spring migratory periods, based on weekly censuses at national wildlife refuges - 1957, 1962, and 1967 (adapted from Bellrose 1976).

The wigeon is one of the earliest species of waterfowl to migrate southward; they begin to arrive on the wintering grounds in late September and early October (Fig. 8-1). Spring migration commences in early February and proceeds through March.

Gadwall - Gadwalls are found on slightly brackish marshes and ponds with submerged aquatic vegetation (e.g., pondweeds, southern naiad, widgeongrass, coontail, Chara spp. (muskgrass), and eel grass). Like wigeon, they prefer the stems and leaves of plants for food, and the two species often frequent the same habitats. The wintering gadwall population in the Atlantic flyway numbers 40,000 birds, 75% of which occur in South Carolina (Bellrose 1976).

Landers et al. (1976) showed that sedges, red root, and widgeon grass were consumed in large quantities by gadwalls. Soft-stem bulrush and southern naiad were found to be the most important food items in a study by Kerwin and Webb (1972). McGilvrey (1966b) reported that the seeds of soft-stem bulrush, the vegetative parts of southern naiad, and leafy pondweed were principal food items.

The peak of fall migration on the southeast coast is in mid-November (Fig. 8-1). Spring migration begins in February, but not until late April have most of the gadwall dispersed from the wintering grounds.

Green-winged teal - Coastal marshes are the preferred winter habitats of green-winged teal. They also utilize creeks and ponds that are bordered by mud flats at low tide; tidal creeks and marshes near estuaries are preferred over salt marshes (Johnsgard 1975). The Atlantic flyway winters approximately 77,000 green-winged teal. Seventy percent of these winter along coastal South Carolina, whereas only 5% winter along Georgia's coast (Bellrose 1976).

Green-winged teal prefer to search for food on mud flats, but will also seek food on the shallow marshes and/or temporarily flooded agricultural lands. They prefer seeds of moist soil plants, as well as insects and mollusks. Bellrose (1976) reported that seeds of panic grasses, bulrush, pondweeds, Olney's three-square bulrush, and widgeon grass were preferred food items. Landers et al. (1976) and Kerwin and Webb (1972) also showed that panic grasses, sedges, smartweeds, and bulrushes were important foods for wintering teal.

Most green-winged teal do not arrive at their more southerly wintering areas until late November. In the spring, migration begins in early February and continues through April (Fig. 8-1).

Mallard - The mallard is the most abundant and widely distributed duck in North America. The Atlantic flyway attracts a relatively small portion (200,000) of the total population and over half of these (110,000) winter in southeastern South Carolina (Bellrose 1976).

Mallards are highly adaptable in their utilization of natural and cultivated foods. McGilvrey (1966b) reported that in South Carolina the winter diet of mallards consisted of rice cutgrass seeds, water grass, sweet gum, button bush, and swamp smartweed. In managed tidal impoundments, the seeds of smartweeds were favored by mallards, as were red root and panic grasses (Landers et al. 1976). Kerwin and Webb (1972) found smartweeds, bulrush, and sedges to be of great importance as winter foods.

The mallard has the most prolonged fall migration of any duck (Fig. 8-1). In the South, mallards begin to arrive in early October and continue into the month of December. In the spring, mallards depart their wintering grounds by early February and continue their migration through March.

Black duck - In coastal South Carolina and Georgia, black ducks tend to concentrate in tidewater areas. Estuarine bay marshes, particularly those with salt water, receive high utilization, as do coastal salt marshes and impoundments. Black ducks tend to use saltwater habitats more so than mallards. Fifty thousand black ducks winter in areas south of Virginia (Bellrose 1976).

Eel grass, widgeon grass, and various species of animal matter are the more important food items of black ducks that utilize coastal estuaries. Animal foods (e.g., periwinkles, blue mussels, and various snails) become increasingly important during the winter. Smartweed and saltmarsh bulrush seeds were of high importance to black ducks on managed tidal impoundments (Landers et al. 1976). McGilvrey (1966b) found corn and sweet gum seeds to be important foods for wintering black ducks. Kerwin and Webb (1972), however, showed that pickerelweed, jointed spikerush, swamp smartweed, and saltmarsh bulrush were preferred food items.

Black ducks generally arrive in the coastal areas of South Carolina and Georgia in late November to early December (Fig. 8-1). Their migration into this region is usually delayed until more northern habitats freeze over (Bellrose 1976). Black ducks start their spring migration in early February and continue into early April.

Pintail - Wintering pintails utilize shallow, fresh or brackish estuarine waters with scattered impoundments and adjacent agricultural areas. The pintail is able to winter almost anywhere that a combination of open water and available food may be found (Johnsgard 1975). Approximately 200,000 of these birds winter in the Atlantic flyway. Of these, 87,000 (43.5%), winter in South Carolina (Bellrose 1976).

Pintails consume a variety of foods in the coastal region of the Atlantic flyway. Pintails wintering in South Carolina utilized bulrush, widgeon grass, and redtop (McGilvrey 1966b). Landers et al. (1976) discussed their preference of red root, panic grasses, and smartweeds in managed tidal impoundments. In Kerwin and Webb's (1972) study, saltmarsh bulrush, redtop, and widgeon grass were shown to be the most important foods of pintails.

In South Carolina and Georgia, pintails begin to arrive during fall migration in mid-October and the population continues to increase until a peak population is reached in late December. It is one of the first ducks to migrate north in the spring. Spring migration begins in late January or early February and continues through March (Fig. 8-1).

Blue-winged teal - In the winter, blue-winged teal utilize areas similar to those preferred by green-winged teal (i.e., marsh habitats and/or mud flat areas). It is, however, an early migrant and few remain in the continental United States during the winter. Most spend the winter months in South America and Mexico. Approximately 5,000 blue-winged teal overwinter in South Carolina and small numbers have been found during winter surveys in Georgia (Bellrose 1976).

The blue-winged teal prefers to feed in shallow water where floating and shallowly submerged vegetation and aquatic invertebrates are abundant (Palmer 1976). Twenty-five percent of their diet is comprised of animal matter. They also feed on the vegetative parts of aquatic plants (e.g., muskgrass, duckweeds, widgeon grass, coontail, and pondweeds). Wintering blue-winged teal also prefer Olney's three-square bulrush, sedges, smartweeds, and wild millet (Landers et al. 1976). Kerwin and Webb (1972) found a preference for corn, Asiatic dayflower, jointed spikerush, swamp smartweed, and sedges.

Blue-winged teal are generally the first ducks to migrate south in the fall and the last to migrate north in the spring. Large numbers appear in South Carolina and Georgia during September, but diminish rapidly during October with small numbers remaining the rest of winter (Fig. 8-1). The peak of spring migration on the southeast coast is during late March. It is usually late April before the first blue-winged teal arrive on the Canadian breeding grounds.

Northern shoveler - In the winter, shovelers generally utilize freshwater meadows and avoid saltwater habitats. They are most common on still-water ponds subject to slight tidal variations. The Atlantic coast winters approximately 20,000 shovelers (Bellrose 1976). The majority (15,000) of these winter in South Carolina; a small number of shovelers overwinter in Georgia (Bellrose 1976).

The shoveler consumes a considerable amount of small aquatic animal life (e.g., ostracods, copepods, aquatic beetles, and small mollusks) (Bellrose 1976). In coastal South Carolina, the seeds of panic grasses, bulrushes, and spikerush are heavily utilized (McGilvrey 1966b). Landers et al. (1976) showed the importance of panic grasses, red root, saltmarsh bulrush, and smartweeds to wintering shovelers. Fall panic grass, Asiatic dayflower, softstem bulrush, and squarestem spikerush are also preferred foods of shovelers (Kerwin and Webb 1972).

In the fall, peak numbers are not reached on southern wintering grounds until mid- to late November (Fig. 8-1). Spring migration commences in February and continues into early April.

Canvasback - Approximately half of the North American population of canvasbacks overwinter along the Atlantic flyway. Wintering birds occur as far south as central Florida, but the largest concentrations have been reported from the Chesapeake Bay area (75% of the Atlantic flyway population). Brackish estuarine bays are the principal wintering habitats for canvasbacks; saltwater and freshwater estuarine bays are not utilized extensively.

Historically, the winter distribution of canvasbacks has been associated with the distribution of wild celery. In recent years, the abundance of this food resource has been reduced and the food habits of canvasbacks have changed accordingly. In the Southeast, the vegetative parts of arrowhead and banana water-lily are preferred foods (Johnsgard 1975). Recently, a study in South Carolina indicated the importance of baltic clams (Macoma baltica) in estuarine bay habitats and banana water-lily in coastal impoundments to wintering canvasbacks (Alexander and Hair 1977). It seems that with the decline in the abundance of plant foods, canvasbacks have changed to a molluscan diet (Perry 1975).

The peak of fall migration along the southeast coast occurs in late November to early December (Bellrose 1976). Spring migration commences in early February and proceeds at a steady rate through March (Fig. 8-2).

Redhead - Redheads prefer fresh and slightly brackish estuarine bays during spring and fall migration. Typical wintering areas include large bodies of water along the coast that are well protected and fairly shallow; they can range from brackish to saline (Johnsgard 1975). Approximately 60,000 redheads winter along the Atlantic coast, but very few (approximately 300) have been reported from coastal areas of South Carolina and Georgia (Bellrose 1976).

Redheads forage more commonly in marshes, sloughs, and ponds than other diving ducks, and feed extensively on

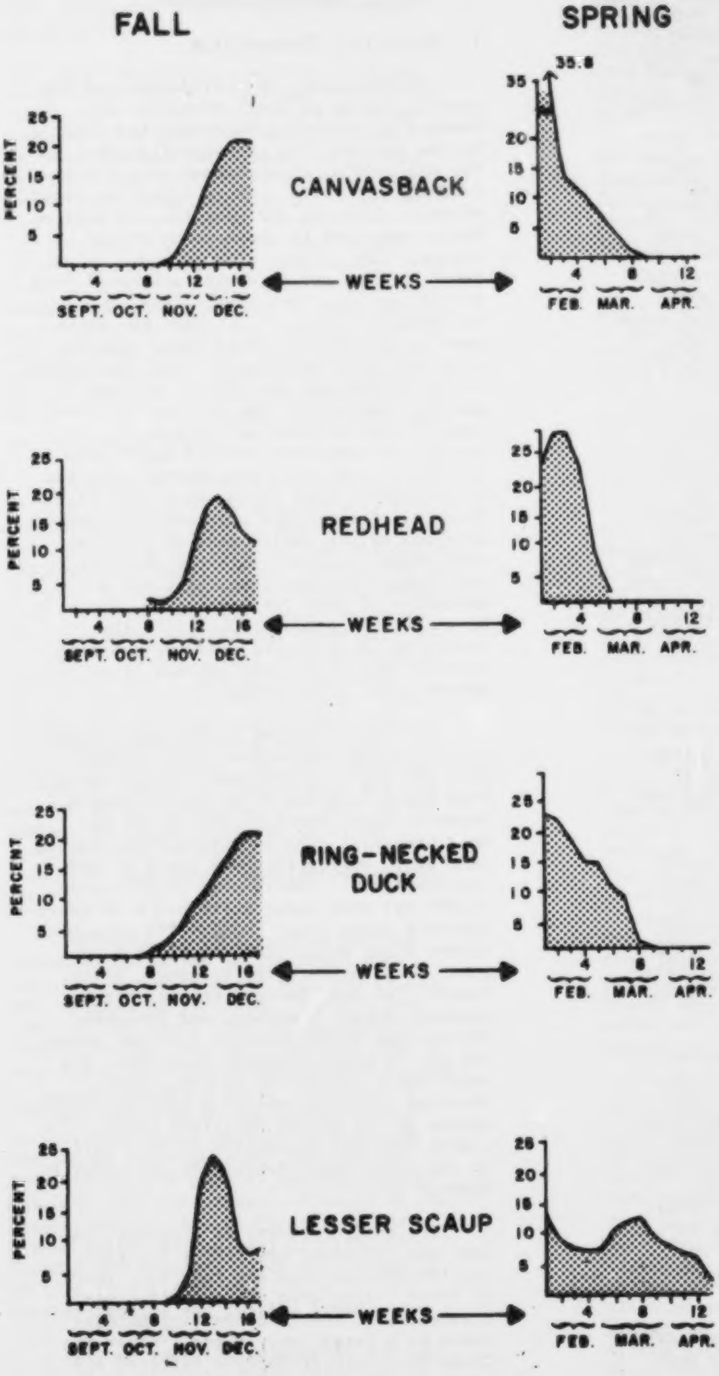

Figure 8-2. The chronology of diving duck migration on the Southeastern coast during fall and spring migratory periods, based on weekly censuses at national wildlife refuges - 1957, 1962, and 1967 (adapted from Bellrose 1976).

aquatic plants (90% plant, 10% animal matter). Along the southeast coast, redheads reach peak numbers during fall migration in late November and early December (Fig. 8-2). Redheads begin to depart from their wintering grounds in early February and continue until mid-March.

Ring-necked duck - Throughout the Southeast, ring-necked ducks utilize marshes, lakes, ponds, and reservoirs as winter habitat. During this time, they generally favor shallow, acid marshes and coastal lagoons, and prefer less brackish conditions than do scaup. The Atlantic flyway winters 44% of the continental population of ring-necked ducks, with major concentrations in South Carolina, Georgia, Florida, and Alabama (Bellrose 1976).

Ring-necked ducks feed in shallower water than other diving ducks (less than 6 ft or 1.8 m). Their preferred winter food in the Southeast consists of the seeds of water-shield, pondweeds, sedges, smartweeds, and the leafy structures of coontail, pondweeds, and duckweeds (Kerwin and Webb 1972). Landers et al. (1976) reported that panic grasses, smartweeds, saltmarsh bulrush, and red root were important food items during the winter on tidal impoundments.

Ring-necked ducks begin to arrive on the Southeastern coast in late October and attain peak winter populations in December (Fig. 8-2). They start to leave their wintering areas in early February and continue through March.

Lesser scaup - The Atlantic flyway winters 31% (455,000) of the total population of lesser scaup. Most occur in Florida, but South Carolina and Georgia have populations of approximately 20,000 wintering birds (Bellrose 1976). Brackish estuarine bays are their chief wintering habitat (Stewart 1962).

In coastal South Carolina, Kerwin and Webb (1972) noted the importance of the seeds of panic grasses, smartweeds, and bulrushes to wintering scaup. Animal matter made up less than 1% of their diet. Other studies show animal life to be more important than plants in scaup diets (Harmon 1962, Rogers and Korschgen 1966). Widgeon grass and saltmarsh bulrush were important foods of scaup collected on managed tidal impoundments in South Carolina (Landers et al. 1976).

Lesser scaup arrive on the southeastern coast in late October and their numbers continue to increase through November and into December (Fig. 8-2). Spring migration is a long drawn-out process; it commences in February and continues through late April.

B. COASTAL WATERFOWL HABITATS

1. Historical Perspectives

Historically, the utilization of the coastal region of South Carolina and Georgia by wintering waterfowl was limited by the availability of natural foods. In the mid-1600's, this changed with the introduction of rice culture along the coast of South Carolina and Georgia. As well as being important to the economy of the region, rice culture also provided a "managed" habitat and alternate source of food for winter waterfowl populations. According to Heyward (1937), ". . . When the ducks came in the fall of those days, they not only came in great numbers, but they stayed in the fields day and night, for then it was the practice of the planters to flood their fields as soon as the crop was harvested and keep them flooded until late in the winter when work for another crop had to be begun. When there was a late fall, from the rice stubble a second crop would grow and mature small heads of rice, so that these, together with the shattered rice from the first crop, afforded an abundance of food for the ducks. Early in November they began to pour into the fields in large flocks, and not being constantly shot at as they are now, they remained until early spring."

By 1690, rice was a well established crop and rice plantations were located near the mouths of the major river systems from North Carolina to southern Georgia. However, South Carolina was by far the most important rice producing State during that era. During the peak years of production (1850 - 1860), over 20,000 acres (8,094 ha) were under cultivation in South Carolina alone (Doar 1936). The principal rivers along which rice was planted in South Carolina were the Waccamaw, Black, Sampit, Pee Dee, Santee, Cooper, Edisto, Ashepoo, Broad, Combahee, and Savannah. Georgia and South Carolina produced almost 90% of the total national rice crop, and until 1860, Georgetown County, South Carolina produced more rice than any other county in the Nation (Hilliard 1975). For a more detailed discussion of rice culture in the Sea Island Coastal Region, refer to Chapter Six.

The entire process of clearing the land and preparing new fields for rice cultivation was slow and took many years of labor. Even when the operation was completed, it required constant maintenance by a large labor force. After the Civil War, rice production faltered and never recovered because of the physical destruction to the plantations and the loss of slave labor. The final demise of rice culture in the South Atlantic region was caused by the introduction of rice into Louisiana, Mississippi, Arkansas, and Missouri.

As rice culture gradually declined in the late 1800's, the diked fields were abandoned. In the first years of abandonment, rice-producing areas probably achieved maximum performance in serving as winter habitats for waterfowl. Abandoned rice fields were quickly vegetated by desirable freshwater marsh plants, such as wild rice, duck potato, square stem spikerush, Olney's three-square bulrush, wild millet, soft-stem bulrush, and water hemp. Interspersed in these marshes were functional rice plantations, and the rice produced by these plantations augmented the natural food supply. Almost a perfect balance between food and cover was achieved and an ideal habitat for waterfowl was created.

Soon after the decline of rice culture in South Carolina and Georgia, some plantations were sold to wealthy northern industrialists who repaired and maintained the dikes and water control structures in order to develop waterfowl hunting areas. Some rice was grown to attract ducks to the plantation and natural foods were encouraged. To facilitate shooting, small ponds were dug in the marsh and were baited with shelled corn or rice. Live decoys were used and hunting occurred in the marshes from morning until night. A hunter seldom went to his blind without a case of shells. Plugging your gun was unheard of and there was no limit to the number one could shoot (R. Wood, 1947, South Carolina Wildlife and Marine Resources Department, Charleston, unpubl. data).

Subjected to such intense hunting pressure, ducks fed in the fresh and brackish waters at night and flew to the salt marshes at daybreak. Devil's Den, just off the coast near McClellanville, South Carolina, and now a part of the Cape Romain National Wildlife Refuge, was a renowned shooting area. Although it offered little food, the ducks were intercepted on their morning flight from the Santee Delta marshes. Murphy and Cedar islands, a part of the old Santee Gun Club, and the marshes of South Island Plantation, located at the tip of the Santee Delta, have always provided good hunting and continue to do so, primarily because they lie in the line of flight between feeding and resting areas.

Through improved management and law enforcement efforts, ducks were held in the impoundments throughout the day, and hunting success was improved. By 1942, about 20,000 acres (8,094 ha) of marsh were diked and privately managed for waterfowl in the Santee Delta. At that time, the Santee River estuary in South Carolina was one of the most important waterfowl areas on the entire coast of the Southeastern United States.

The greatest number of ducks killed in the Santee Delta area occurred during the period from 1920 to 1928. Santee Gun Club members harvested 6,388 birds in 1921-22, while Kinloch Club members bagged 3,082 ducks in 1924 and 3,126 in 1927 (R. Wood, 1947, South Carolina Wildlife and Marine Resources Department, Charleston, unpubl. data). A summary of historical kill records available from hunting clubs in the Santee Delta is shown in Table 8-2.

Prior to diversion of the Santee River (before 1942), the dominant marshes in the Santee Delta area were of the freshwater and brackish types. Natural river fluctuations provided a dependable supply of fresh and salt water, which greatly facilitated waterfowl management. During high flows, fresh water could be impounded to promote growth of desirable duck food plants, as mentioned earlier. At low flows, and with an incoming tide, salt water was available for controlling undesirable freshwater plants such as cut grass, cat-tails, and willows. Further down the estuary, brackish marshes could be maintained by proper mixing of waters; in sizable areas this occurred naturally. Salt marshes, less valuable for waterfowl production, were confined to a narrow coastal fringe by the large freshwater outflow.

Following diversion in 1942, conditions changed rapidly. Existing water-control structures were inadequate to properly manage the marshes with the restricted supply of available fresh water. Salt marshes became the dominant type, brackish marshes moved up the estuary, and freshwater marshes were all but eliminated. Over the next 20 years, new dikes and control features were added to aid in management of many areas as brackish marshes. Today, about 19,837 acres (8,028 ha) of marsh are under active management in the Santee Delta area (Tiner 1977).

Since 1965, when the U.S. Army Corps of Engineers proposed to redivert the Santee River to reduce shoaling in Charleston Harbor, there has been great concern over potential impacts on waterfowl resources in the Santee Delta. According to the U.S. Army Corps of Engineers (1974a), about 9,000 acres (3,642 ha) of swamps would be flooded due to increased river flows. These new supplies of water would increase timber growth and mast production, thereby benefiting waterfowl and wildlife in general. Waterfowl habitat would be improved in about 38,000 acres (15,378 ha) of estuarine habitat, according to the Corps of Engineers. These improvements would be largely due to increased freshwater duck food plants in the delta as opposed to mostly brackish water plants at present. For a more detailed discussion on the impacts of rediversion, the reader is referred to Volume One, Chapter Six.

Table 8-2. Summary of waterfowl harvest records (total number of ducks killed/season) for the Santee Delta region, 1922 - 1947 (R. Wood, 1947, South Carolina Wildlife and Marine Resources Department, Charleston, unpubl. data).

Year	Total	South Island	Cat Island	Annandale	Winyah	Kinloch	Doar[a]	Rice Hope	Santee Gun Club
1947	1,883	305	25[b]	50[b]	0	201	8	16	1,286
1946		985				372		115	2,647
1945		1,021				528		256	2,112
1944		931				387		147	2,285
1943		1,137				727		40	2,212
1942		918			8	793		105	2,268
1941		886			127	1,000		77	2,774
1940		561			95	585		31	2,367
1939		504			104	690		55	2,113
1938		387			186	495		5	1,634
1937		391			74	390		6	1,223
1936		302			210	146		1	1,242
1935		518			159	465		12	1,792
1934		998				1,012		61	3,760
1933		586				754		50	3,172
1932		647				644		105	1,831
1931		689				856		41	2,945
1930		476				934		188	3,541
1929						1,343		293	2,827
1928						2,869		322	4,720
1927						3,126			4,722
1926						3,059			4,406
1925						2,412			5,822
1924						3,082			5,737
1923									5,956
1922									6,388

a. On Woodside and River Hope, Mr. Doar states that over 700 ducks were killed annually prior to 1924.
b. Estimate only - no records available.

At present, marshes (brackish and freshwater) and man-made impoundments are the most important types of waterfowl habitats in the coastal areas of South Carolina and Georgia. Based on available information (detailed below), there is approximately twice as much designated waterfowl habitat in private, State, and Federal ownership in the coastal region of South Carolina as there is in Georgia.

2. Waterfowl Habitat Under Private Control

The total acres of waterfowl habitat in private ownership in the Sea Island Coastal Region are difficult to estimate. Along the coast of South Carolina, there are seven major river systems, including the Pee Dee, Black, Santee, Cooper-Ashley, Edisto-Ashepoo-Combahee, and the Savannah. The major drainage systems in coastal Georgia are the Savannah, Ogeechee, Altamaha, Satilla, and St. Marys rivers. All are important components of the total waterfowl habitat resource base of this region.

Although a comprehensive evaluation of privately owned coastal habitats important to waterfowl has not been made, a detailed study by Morgan (1974) of the Edisto-Ashepoo-Combahee drainage system (in Charleston, Colleton, and Beaufort counties, South Carolina) illustrates the importance of these areas to waterfowl. Of the 335,629 acres (135,827 ha) within the boundaries of Morgan's (1974) study area, 98,451 acres (39,842 ha) (29%) were wetlands. The wetlands consisted of tidelands (defined as any wetland never having been diked that is affected by salt, brackish, or freshwater tidal flow), managed and abandoned rice fields, and managed and abandoned impoundments that were constructed since the era of rice culture. The acreages occupied by these types are presented by river system and by ownership in Table 8-3. All data are from Morgan (1974).

Most of these wetlands (92,346 acres or 37,372 ha) were claimed by 52 private landowners. Two areas encompassing 4,339 acres (1,756 ha) of wetlands were owned and managed by State agencies, and another 1,766 acres (715 ha) were not accounted for in the tax records (Table 8-3). The private claims to ownership of much of these wetlands have been disputed by the State of South Carolina. The privately claimed wetlands were generally parts of estates on adjoining high ground. The amount of marsh claimed by each owner ranged from 172 to 839 acres (70 - 340 ha) with an average of 376 acres (152 ha).

In Morgan's study area, there were 213 impoundments comprising 22,536 acres (9,120 ha), of which 15,670 acres (6,342 ha) or 69% were rediked former rice fields. Including abandoned rice fields, a total of 37,070 acres (15,002 ha) of rice fields which were once used in growing rice commercially were present in Morgan's study area (Table 8-3). These are minimum acreages because in some instances older rice fields, especially those in inland swamps, were not discernible on aerial photographs.

Morgan (1974) made an estimate of new dikes and impoundments constructed from 1959 to 1972. The linear extent of dikes, the number of ponds constructed, and the acres of wetlands impounded from 1959 to 1972 within the Edisto-Ashepoo-Combahee drainage are given in Table 8-4. Although data from the Combahee and upper Ashepoo rivers are incomplete, at least 2,015 acres (815 ha) were impounded: 1,562 acres (632 ha) by the State of South Carolina and 453 acres (183 ha) by private landowners. All of this diking was in the brackish zone. See Morgan (1974) for further details.

The Santee Delta (Georgetown County) represents another important area in South Carolina where active waterfowl management on privately owned land takes place. For example, Kinloch Plantation, located on the north side of the Santee River, is one of the most important private waterfowl properties along the Southeast Atlantic coast. Kinloch has approximately 5,000 acres (2,023 ha) of marsh with an excellent system of dikes and water control structures, plus a good supply of fresh water. There are a number of other plantations which also manage impoundments for waterfowl, but relevant information is not available.

There are a substantial number of man-made impoundments in private or public ownership along the coast of South Carolina and Georgia. In 1974, the South Carolina Water Resources Commission inventoried all of the man-made lakes greater than 10 acres (41 ha) in size (Coleman and Dennis 1974). Collectively, they impound 74,266 surface acres (30,055 ha) of water. Of this total, 58 impoundments (25%) comprising 4,496 acres (1,820 ha) (6%) were specifically designated as waterfowl habitats (Table 8-5). Comparable data were not available for Georgia.

3. Waterfowl Habitat Under State Control

South Carolina controls eight wildlife management areas in the Sea Island Coastal Region (Table 8-6). These areas total approximately 42,000 acres (16,997 ha) (combined upland and wetland habitats) of which 7,054 acres (2,855 ha) (17%) are available for public hunting. The latter figure reflects those areas that will not be made available to public waterfowl hunting until a future date because of various legal agreements made during acquisition, e.g., Santee Coastal Reserve - 24,000 acres (9,713 ha).

In Georgia, the Altamaha Waterfowl Management Area is the only State

Table 8-3. Acres[a] of tidal marsh and managed and abandoned impoundments along the South Edisto, Ashepoo, and Combahee rivers, 1972 (Morgan 1974).

Wetland Type	South Edisto River			Ashepoo River		Combahee River	Total Study Area
	Private[b]	State[c]	Untitled[d]	Private[b]	State[c]	Private[b]	
Tidelands never diked:							
fresh				396			396
brackish	521			512	29		1,062
salt	12,918	148	1,766	7,735	608	29,454	52,629
Total							54,087
Abandoned diked areas open to tidal ebb and flow							
Old rice fields:							
fresh	1,752			4,366		8,040	14,128
brackish	3,138			1,054		8,080	7,272
Areas diked since rice culture:							
fresh	4					253	257
brackish	116			55			171
Total abandoned diked areas							21,828
Diked impoundments							
Former rice fields under management in 1972:							
fresh	2,714			1,306		5,182	9,202
brackish	1,643	647		115	878	3,185	6,468
Managed impoundments constructed since rice culture:							
fresh	2,529			358		159	3,046
brackish	782	192		540	1,837	469	3,820
Total under water control							22,536
Total Acres	26,117	987	1,766	16,407	3,352	49,822	98,451

[a] 1 acre = 0.405 ha.

[b] Those wetlands on which taxes were being paid by private landowners.

[c] Those wetlands within the boundaries of the Bear Island Wildlife Management Area and the Edisto Beach State Park.

[d] Those wetlands not included in footnotes b and c.

Table 8-4. Construction of new dikes and acres impounded during 1959 - 1972 within the Edisto-Ashepoo-Combahee River drainage, South Carolina (Morgan 1974).

River System	1959 - 1968 Number of Ponds	1959 - 1968 Feet of Dikes	1959 - 1968 Acres[a]	1969 - 1972 Number of Ponds	1969 - 1972 Feet of Dikes	1969 - 1972 Acres[a]
State:						
South Edisto	1	10,736	222			
Ashepoo[b]	6	22,875	1,340			
Private:						
South Edisto	2	1,475	35			
Ashepoo[b]	8	23,135	253	2	7,001	72
Combahee	1	533	29	3	6,347	64
Total for Study Area:						
Private	11	25,143	317	5	13,348	136
State	7	33,611	1,562	--	--	--

a. 1 acre = 0.405 ha.

b. Coverage for Combahee River and upper portion of Ashepoo River is incomplete for the years 1959 - 1968.

Table 8-5. Man-made impoundments and managed waterfowl areas in the Sea Island Coastal Region of South Carolina (Coleman and Dennis 1974).

County	Lakes (≥ 10 acres) Total Number	Lakes (≥ 10 acres) Managed[a]	Surface Area Total	Surface Area Managed[a]	Capacity (acre feet) Total	Capacity (acre feet) Managed[a]
Beaufort	30	10	1,452	232	4,580	706
Berkeley	43	0	64,050	0	1,235,431	0
Charleston	78	31	4,800	3,024	18,949	9,122
Colleton	32	3	2,547	860	6,530	2,580
Dorchester	10	0	388	0	2,245	0
Georgetown	14	5	277	97	511	177
Jasper	27	9	752	283	4,085	987
Totals	234	58	74,266	4,496	1,272,331	13,572

a. Specifically designated as waterfowl or wildlife habitat.

Table 8-6. Waterfowl habitat controlled by the State of South Carolina (South Carolina Wildlife and Marine Resources Department, Columbia, unpubl. data).

Wildlife Management Area	Acreage Open To Hunting	Total Acreage[a]
Bear Island	2,000	7,500
Hatchery Pool	2,454	2,454
Pee Dee	900	1,275
Santee Coastal Reserve	0	24,000
Santee-Cooper	200	1,275
Santee Delta	1,500	1,500
Turkey Creek	0	2,000
Yawkey Wildlife Center	0	2,356
Total	7,054	42,360

a. 1 acre = 0.405 ha.

controlled land managed for waterfowl in the coastal region. It is, however, a large area (35,000 acres or 14,164 ha) of which over 85% (30,000 acres or 12,141 ha) is open to public hunting.

4. Waterfowl Habitat Under Federal Control

Nine National Wildlife Refuges managed by the U.S. Department of the Interior, Fish and Wildlife Service, and comprised of over 180,000 acres (72,845 ha), are located along the coasts of South Carolina and Georgia. Important features of each, particularly as they relate to waterfowl resources, are discussed in the following paragraphs. Chapter Nine also discusses the refuges as they relate to public recreation in general. The order of discussion is based on their respective locations from north to south. (See Atlas plates 27 and 29.)

a. Cape Romain National Wildlife Refuge (Charleston County, South Carolina). Cape Romain was established as a national wildlife refuge in April 1930. It is a diverse area with many low-lying barrier islands and thousands of acres of marsh cut by a maze of tidal creeks and bays. Refuge-owned lands are made up of 1,500 acres (607 ha) of forest land, 985 acres (399 ha) of freshwater impoundments, 85 acres (34 ha) of farmland or wildlife openings, nearly 20 mi (32.2 km) of sandy beaches and dunes totalling 1,700 acres (688 ha), and approximately 26,960 acres (10,911 ha) of salt marsh (U.S. Department of Interior, Fish and Wildlife Service 1977b). Aquatic plants like banana waterlily, sago pondweed, and widgeon grass grow in the deeper water areas. Excellent stands of foxtail grass, wild millet, smartweed, bulrush, spikerush, and other waterfowl food plants grow on the exposed marsh flats. The management of Cape Romain National Wildlife Refuge is directed toward maintaining a natural island and estuarine environment for wintering waterfowl, nesting shore birds, and sea turtles. With the exception of Bull Island, no habitat improvement practices are considered necessary. Cape Romain National Wildlife Refuge has 28,000 acres (11,331 ha) included in the National Wilderness System.

Waterfowl wintering on the freshwater impoundments and in the bays often reach peak concentrations of 40,000 birds during migration periods. Totals for 1977 were somewhat lower (Table 8-7). The largest concentrations of waterfowl in 1977 were in Jack's Creek Pond on Bull Island (U.S. Department of Interior, Fish and Wildlife Service 1977b). Lower Summerhouse and Moccasin ponds also were utilized heavily. Bull Island had 20,000 wintering ducks, including approximately 2,500 canvasbacks. There were 200,000 ducks, most of which were diving ducks, on the entire refuge during peak times, but they do not stay for extended periods

Table 8-7. The estimated monthly waterfowl populations on the Cape Romain National Wildlife Refuge in 1977; these figures represent an average of four weekly surveys conducted by refuge personnel (U.S. Department of the Interior, Fish and Wildlife Service, Cape Romain National Wildlife Refuge, unpubl. data).

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
American coot	586	225	151							375	3,000	1,557	5,894
Whistling swan	8	15	8								6	22	59
Snow and blue goose	2									12		2	16
Canada goose													--
Mallard duck	125	150	16							10	720	80	1,101
Black duck	43	42	15							40	30	36	206
Gadwall	5	30	22								3,000	18	3,075
Pintail	15	2									1,000	25	1,042
Green-winged teal		5										15	20
Blue-winged teal	55	97	20	20	4			30	30	75	160	132	623
American wigeon	148	4								735	2,000	778	3,665
Shoveler	58	94	40							20	95	23	330
Wood duck	7	200	200	200	250	250	200	200	200	200	110	8	2,025
Redhead	5										100	7	112
Ring-necked duck	35	1,500								35	400	342	2,312
Canvasback	518	77	15								2,500	1,602	4,712
Scaups	135	1,000	5,030	100	10						500	143	6,918
Bufflehead	8	2	6								70	9	95
Ruddy duck	72	39	11							25	150	148	445
Red-breasted merganser		2	11	10	2								25
Hooded merganser	2	20	2	10							25	18	77
Black scoter			5,020										5,020
Total	1,827	3,504	10,567	340	266	250	200	230	230	1,527	13,866	4,965	37,772

of time. The refuge also has a successful wood duck nest box program (U.S. Department of Interior, Fish and Wildlife Service 1977b).

b. Santee National Wildlife Refuge (Clarendon and Berkeley counties, South Carolina). The Santee National Wildlife Refuge was established on 31 July 1941. It is situated on the Santee-Cooper Reservoir, lakes Marion and Moultrie. The Santee National Wildlife Refuge is comprised of approximately 75,000 acres (30,352 ha) and is managed specifically for wintering waterfowl. Duck utilization of the refuge has been good in previous years, and black duck use, in particular, is increasing. Corn is planted by refuge personnel and co-operative farmers on a share basis. The refuge's share is mainly left in the fields for the wintering birds. In 1977, the Santee Refuge saw peaks of 173,000 ducks, 15,000 coots, and 6,000 geese (Strange 1977).

c. Pinckney Island National Wildlife Refuge (Beaufort County, South Carolina). Pinckney Island National Wildlife Refuge was acquired by the U.S. Fish and Wildlife Service on 4 December 1975. The refuge, totalling 4,052 acres (1,640 ha) consists of Pinckney Island, Little Harry Island, Big Harry Island, Buzzard Island, and Corn Island, plus another 2,800 acres (1,133 ha) of estuarine salt marsh. The refuge is not officially open to the public. Pending funding for the management of this acquisition, no public use activities are authorized. The refuge's upland habitat provides a breeding ground for the usual complement of game birds and mammals normally associated with the low country of South Carolina.

d. Savannah National Wildlife Refuge (Jasper County, South Carolina, and Chatham County, Georgia). The Savannah National Wildlife Refuge was created on 6 April 1927. On 7 January 1978, 13,480 acres (5,455 ha) comprising Argent Swamp on the Savannah River were acquired from the Union Camp Corporation, doubling the size of the refuge to 26,555 acres (10,747 ha). The majority of the refuge land consists of freshwater marsh and tidal rivers and creeks. Cutgrass is by far the most prevalent marsh plant; however, scattered stands of wild rice, smartweeds, soft-stem bulrush, and other natural waterfowl food plants are common throughout the marshes. Most impoundments now used for migratory waterfowl were formerly rice fields of pre-Civil War rice plantations. There are 3,000 acres (1,214 ha) of freshwater impoundments, managed primarily for wintering waterfowl populations. However, there has been extensive deterioration of water management capabilities, and the refuge has fallen far behind its primary waterfowl use objectives. Unless rehabilitation is completed, it is unlikely that the refuge's primary waterfowl use objectives can be realized.

Peak waterfowl populations normally reach 40,000 during the winter season. Mallards, pintails, green-winged teal, ring-necked ducks, and wood ducks account for approximately 70% of the waterfowl use on the refuge (Table 8-8). Savannah refuge has a year-round population of wood ducks and peak numbers (10,000) occurred during December 1977.

Waterfowl hunting is permitted on a portion of the refuge's marsh acreage within the State of Georgia. The hunting season on the refuge coincides with the Georgia season. Hunting conditions are classified as poor.

e. Wassaw Island National Wildlife Refuge (Chatham County, Georgia). The Nature Conservancy conveyed Wassaw Island to the U.S. Fish and Wildlife Service on 30 October 1968. Wassaw is a coastal barrier island and has a total acreage of 10,064 (4,073 ha). The topography consists of wide beaches, rolling dunes, and woodlands. The majority of the refuge contains salt marsh, dominated by smooth cordgrass interspersed with scattered marsh hummocks. The island supports rookeries for egrets and herons. Ospreys also nest on the refuge.

Management is directed primarily toward practices that will maintain the refuge area in a natural state without major changes in habitat. The emphasis is being placed on protecting certain species of endangered wildlife (e.g., alligator, brown pelican, and loggerhead turtle). During 1977, no wetland habitat management was applied. Waterfowl numbers decreased during this year, primarily because of the decline in lesser scaup, which is generally the dominant species of wintering duck on the refuge. During January 1977, approximately 20,408 ducks used the refuge, of which 20,000 were lesser scaup (Table 8-9). Most of the duck use-days were within saltwater sounds and bays that surround the island. The refuge maintains a nesting program for wood ducks and, in 1977, 24 of 25 boxes were active and 150 ducklings were hatched.

f. Tybee Island National Wildlife Refuge (Chatham County, Georgia). The Tybee Island National Wildlife Refuge consisting of 400 - 500 acres (162 - 202 ha) was established on 5 May 1933. The primary objective was to provide a refuge and breeding area for migratory birds and other wildlife. It consists mainly of Oysterbed Island, which is essentially a spoil bank that serves as a resting place for migratory birds. Although ducks, geese, and coots may occasionally be observed on or near the refuge, Tybee is of little value to waterfowl (Table 8-10). The tidal flats and sandy beach areas are used as resting and feeding areas for

Table 8-8. The estimated monthly waterfowl populations on the Savannah National Wildlife Refuge in 1977, these figures represent an average of four weekly surveys conducted by refuge personnel (U.S. Department of the Interior, Fish and Wildlife Service, Savannah National Wildlife Refuge, unpubl. data).

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
American coot	3,600	2,000	1,400	1,000	150	50	30	45	50	100	600	3,000	12,025
Whistling swan	15	25	25	25									90
Snow and blue goose		4	3										7
Canada goose		10	7										17
Mallard duck	3,600	3,000	900	10							50	1,000	8,560
Black duck	600	600	90	5							25	400	1,720
Gadwall	300	200	500								40	200	1,240
Pintail	2,000	3,000	745	20							50	600	6,415
Green-winged teal	5,000	7,000	2,230	100							10	2,000	16,340
Blue-winged teal	180	200	320	65						25	300	300	1,390
American wigeon	1,000	500	300	50							30	600	2,480
Shoveler	350	800	540	125								150	1,965
Wood duck	4,000	3,500	1,130	550	600	650	1,000	1,000	1,000	1,100	1,500	10,000	26,030
Redhead		5	3								4		12
Ring-necked duck	3,500	1,500	135								200	5,000	10,335
Canvasback	400	650	505	5							5	50	1,615
Scaups	15	20									50	20	105
Bufflehead	5												5
Ruddy duck	50	50	40								5	10	155
Red-breasted merganser													--
Hooded merganser	20	100	10										130
Black scoter													--
Total	24,635	23,164	8,883	1,955	750	700	1,030	1,045	1,050	1,225	2,869	23,330	90,636

Table 8-9. The estimated monthly waterfowl populations on the Wassaw Island National Wildlife Refuge in 1977; these figures represent an average of four weekly surveys conducted by refuge personnel (U.S. Department of the Interior, Fish and Wildlife Service, Wassaw Island National Wildlife Refuge, unpubl. data).

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
American coot	40	20	20	10							6	20	116
Whistling swan													--
Snow and blue goose													--
Canada goose													--
Mallard duck	20	30	10	6								20	86
Black duck	30	20	16	2								20	88
Gadwall		8	2										10
Pintail	10	10	4	2									26
Green-winged teal	20	20	14	8								20	82
Blue-winged teal	70	60	20	20	20					12	20	20	242
American wigeon	20	15	15	4								8	62
Shoveler	6	6	6	2									20
Wood duck	80	60	50	100	100	120	120	120	130	140	30	60	1,110
Redhead													--
Ring-necked duck	6	8	8										22
Canvasback		30	15										45
Scaups	20,000	5,000	5,000	5,000								2,000	37,000
Bufflehead	6	6	2										14
Ruddy duck	10	8	4										22
Red-breasted merganser	40	40	30	10	6							4	130
Hooded merganser	50	20	16	6									92
Black scoter												6	6
Total	20,408	5,361	5,232	5,170	126	120	120	120	130	152	56	2,178	39,173

Table 8-10. The estimated monthly waterfowl populations on the Tybee Island National Wildlife Refuge in 1977; these figures represent an average of four weekly surveys conducted by refuge personnel (U.S. Department of the Interior, Fish and Wildlife Service, Tybee Island National Wildlife Refuge, unpubl. data).

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
American coot													--
Whistling swan													--
Snow and blue goose													--
Canada goose													--
Mallard duck													--
Black duck													--
Gadwall													--
Pintail													--
Green-winged teal													--
Blue-winged teal													--
American wigeon													--
Shoveler													--
Wood duck													--
Redhead													--
Ring-necked duck													--
Canvasback		10	12									12	34
Scaups	25	30	50	35									140
Bufflehead	75	15	8										98
Ruddy duck	10	10											20
Red-breasted merganser	10	10	8	7									35
Hooded merganser													--
Black scoter													--
Total	120	75	78	42	--	--	--	--	--	--	--	12	327

numerous marsh, water, and shore birds. No specific wildlife management programs, other than protection, are in effect or are required to accomplish wildlife objectives.

g. Harris Neck National Wildlife Refuge (McIntosh County, Georgia). The Harris Neck National Wildlife Refuge, totalling 2,687 acres (1,087 ha) was established in 1962 and was once an active military airfield during World War II. It has a great variety of habitats (salt marsh, swamp, woodland, cropland, and grassland) and attracts many different species of birds throughout the year. Harris Neck possesses both land and water management potential to render suitable habitat for Canada geese, most species of diving and puddle ducks that utilize the Atlantic flyway, and numerous species of water, marsh, and shore birds. In the winter, large flocks of ducks traditionally use the area (Table 8-11). The refuge also has a resident flock of Canada geese (200 - 300) and an active wood duck nest box program.

In 1977, habitat management received considerable attention as did maintenance of facilities. Several hundred acres of cropland, grassland, and wetland were maintained for the resident goose flock, as well as for migrant waterfowl. In 1977, 200 acres (81 ha) were fertilized and planted in oats for the Canada geese (U.S. Department of the Interior, Harris Neck National Wildlife Refuge, unpubl. data).

Wood ducks are the only ducks to nest on the refuge. The breeding population is estimated at approximately 400 individuals, and 155 ducklings were raised in 1977. Canada geese also nest on the refuge; 30 nests were discovered in 1977 and approximately 50 young were fledged. The salt marshes and tidal creeks on and near the refuge are attractive to lesser scaup, bufflehead, mergansers, and ruddy ducks. No hunting is allowed on the refuge.

h. Blackbeard Island National Wildlife Refuge (McIntosh County, Georgia). Blackbeard Island was designated a national wildlife refuge in 1940 and contains 5,618 acres (2,274 ha). The island contains approximately 9 mi (14.5 km) of beach on the ocean side, extensive salt marshes on the bay side, two freshwater ponds, and forested areas. Management of the open areas is directed toward production of both natural grasses and forage crops for ducks, deer, and turkey. Three thousand acres (1,214 ha) on the south and west parts of the island have been set aside as a National Wilderness.

In winter months, waterfowl utilize the freshwater ponds and the marshland surrounding the refuge. For approximately 2 weeks in February, 30,000 to 40,000 lesser scaup congregate in the surf adjacent to the beach. During November and December 1977, coots and canvasbacks were the main species utilizing the freshwater ponds (Table 8-12). Mallards, ring-necked ducks, and black ducks concentrate on flooded savannah areas during wet winter months.

i. Wolf Island National Wildlife Refuge (McIntosh County, Georgia). Wolf Island National Wildlife Refuge was established on 3 April 1930 as a sanctuary for migratory birds. In 1972, 4,587 acres (1,856 ha) were added to the original refuge acreage, increasing the total area to 5,126 acres (2,074 ha). The vegetation consists of clumps of sea oats and sandspurs on the low dunes adjacent to the beach. Scattered myrtle bushes and southern red cedar constitute the only woody growth. The remainder of the refuge (approximately 75%) is salt marsh. Wolf Island National Wildlife Refuge has been designated as a National Wilderness Area.

Many species of shore birds frequent the beach throughout the year. Wintering waterfowl populations at Wolf Island were composed mainly of lesser scaup. However, mallards, black ducks, canvasbacks, and mergansers also frequent the surrounding creeks and marshes. During 1977, peak waterfowl populations occurred in April and totalled 1,275 individuals, most of which were lesser scaup (Table 8-13).

C. WATERFOWL HABITAT MANAGEMENT PROCEDURES

The types of habitats most commonly managed for waterfowl in South Carolina and Georgia are coastal marshes, hardwood bottomland, inland lakes and ponds, and in some instances, beaver ponds and upland cultivated areas. The following discussion of waterfowl management procedures is restricted to coastal freshwater and brackish marshes and hardwood bottomlands. Unless otherwise noted, the management recommendations are from an unpublished manuscript by P. M. Wilkinson (South Carolina Wildlife and Marine Resources Department, Charleston), presented at the 1976 South Carolina Waterfowl Symposium, held in Columbia, South Carolina, under the joint sponsorship of the South Carolina Wildlife and Marine Resources Department and the South Carolina Chapter of Ducks Unlimited.

In recent years, there has been a dichotomy of management interests in reference to waterfowl impoundments. This is especially true in the case of newly created impoundments, where wetlands are diked off. On the one hand, there are those who advocate the creation of impoundments, since these areas do, in fact, substantially enhance resting and feeding habitat for waterfowl and wading birds. In contrast, there are those who oppose this practice in the name of conservation

Table 8-11. The estimated monthly waterfowl populations on the Harris Neck National Wildlife Refuge in 1977; these figures represent an average of four weekly surveys conducted by refuge personnel (U.S. Department of the Interior, Fish and Wildlife Service, Harris Neck National Wildlife Refuge, unpubl. data).

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
American coot	475	750	250	115	225	50	30	25	30	40	155	300	2,445
Whistling swan													--
Snow and blue goose	15	10									6		31
Canada goose	260	200	250	290	325	325	325	325	285	300	227	200	3,312
Mallard duck	450	400	180	20							21	250	1,321
Black duck	375	350	150	5							6	175	1,061
Gadwall	25	100	200	30	15						25	25	420
Pintail				5							6	30	41
Green-winged teal	20	100	35									50	205
Blue-winged teal		60		60	45				20	40	85		310
American wigeon	10	50	35	30	20						14	10	169
Shoveler		15			5						4		24
Wood duck	200	150	175	150	275	325	400	410	275	275	175	150	2,960
Redhead													--
Ring-necked duck												20	20
Canvasback													--
Scaups	550	500	450								85	300	1,885
Bufflehead	15	20	12								4		51
Ruddy duck	5	5									6	5	21
Red-breasted merganser	20	5	15		2							5	47
Hooded merganser	5	20	35	5							4	10	79
Black scoter													--
Total	2,425	2,735	1,787	710	912	700	755	760	610	655	823	1,530	14,402

Table 8-12. The estimated monthly waterfowl populations on the Blackbeard Island National Wildlife Refuge in 1977; these figures represent an average of four weekly surveys conducted by refuge personnel (U.S. Department of the Interior, Fish and Wildlife Service, Blackbeard Island National Wildlife Refuge, unpubl. data).

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
American coot	2,500	750	225	175	125	45	35	35	35	40	300	850	5,115
Whistling swan													--
Snow and blue goose													--
Canada goose													--
Mallard duck	450	325	180	20							15	175	1,165
Black duck	350	250	120	25	5						5	65	820
Gadwall	225	110	90	5							15	25	470
Pintail	5	5	2									5	17
Green-winged teal	275	185	85	5							10	45	605
Blue-winged teal	40	30	35	15	25			3	10	55	30	10	253
American wigeon	125	75	20	10								5	235
Shoveler	50	20	30	5							5	20	130
Wood duck	600	550	525	90	85	95	90	155	150	150	225	425	3,140
Redhead	20	12									2	35	69
Ring-necked duck	710	900	125								25	450	2,210
Canvasback	575	750	150								2	150	1,627
Scaups	360	725	12,000	4,500	80							275	17,940
Bufflehead	25	25	10									15	75
Ruddy duck	10	50	25	5								10	100
Red-breasted merganser	12	20	12	5	5	2						10	66
Hooded merganser	20	35	30	10	5							20	120
Black scoter													--
Total	6,352	4,817	13,664	4,870	330	142	125	193	195	245	634	2,590	34,157

Table 8-13. The estimated monthly waterfowl populations on the Wolf Island National Wildlife Refuge in 1977; these figures represent an average of four weekly surveys conducted by refuge personnel (U.S. Department of the Interior, Fish and Wildlife Service, Wolf Island National Wildlife Refuge, unpubl. data).

Species	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
American coot											27		27
Whistling swan													--
Snow and blue goose													--
Canada goose													--
Mallard duck	45	35	25	5							4	10	124
Black duck	75	35	30	10							6	10	166
Gadwall													--
Pintail													--
Green-winged teal													--
Blue-winged teal											12		12
American wigeon													--
Shoveler													--
Wood duck													--
Redhead													--
Ring-necked duck													--
Canvasback	55											5	60
Scaups	375	400	700	1,250	50						80	175	3,030
Bufflehead	10		10	2							6		28
Ruddy duck													--
Red-breasted merganser	5	10	15	4	5	2						5	46
Hooded merganser	2	35	35	2									74
Black scoter													--
Total	567	515	815	1,273	55	2	--	--	--	--	135	205	3,567

because wetlands, in their natural state, are highly productive and supply vital habitat and nursery grounds for many commercial and sport fish and shellfish. When impounded, these wetlands do not function in the same way. There appears to be a distinct lack of data on the detrimental effects of newly created impoundments in the study area. However, both South Carolina and Georgia are now discouraging the impounding of previously undisturbed wetlands.

1. Coastal Marsh Areas

The objectives of waterfowl impoundment management are to provide an optimum interspersion of open water and cover, and to produce a maximum quantity and quality of food supply. If these objectives are accomplished, waterfowl utilization will be increased. Food is the most important requirement on wintering grounds, and therefore, most management efforts are directed toward the elimination or control of undesirable vegetation. The primary concern for effective management of coastal marsh areas is the stabilization and/or control of water levels. Control of water levels is essential for effective and economical management of vegetation in coastal waterfowl impoundments. Water levels can be raised to reduce emergent vegetative cover, or lowered to increase its density, but submerged aquatic food plants require fairly stable water levels throughout the growing season in order to attain the greatest production. The most common methods used to control water levels in coastal marsh areas are: a) pot holes, b) plugs, c) weirs, and d) diked impoundments.

Pot holes are usually created in well-drained high marsh areas, using explosives or heavy earthmoving equipment. However, the small ponds created in this manner are difficult to manage and have yielded varying results as waterfowl management tools. Actual control of water levels in these pot holes is difficult, and natural vegetative succession usually reduces the length of time that these impoundments effectively serve as high-quality waterfowl habitat. This method of attracting waterfowl is not practiced extensively in the Sea Island Coastal Region.

Earthen plugs (small dams) can be placed across natural channels or other drains in marsh areas in order to stabilize water levels, reduce salinity, reduce turbidity, and restrict tidal flow behind the plugs. If these aims are achieved, desired aquatic plant production is favored and waterfowl usage is likely to increase. In areas with relatively large tidal fluctuations, like those found in the Sea Island Coastal Region, flap gates can be installed in the earthen plugs to improve the water management potential in these marsh areas. Flap gates permit excessive water to drain from the area, while prohibiting undesirable water from entering on the incoming tide.

Weirs are similar in function to earthen plugs in that their main purpose is to stabilize water levels. They are constructed in such a manner that water is held behind the weir during low tides, but passes over the weir and into the impounded area during high tides. Thus, water levels behind weirs can recede to only a fixed level, thereby prohibiting excessive drainage of the area during low tides.

The most common method of impounding marshes in the Sea Island Coastal Region is to construct dikes around the desired area. This method allows for the greatest degree of control within the impounded area. Diking, with the appropriate water inlets and drainage outlets, enables the manager to alter conditions within the impoundment so as to encourage desirable plant species and discourage undesirable ones. Most managed waterfowl impoundments in the Sea Island Coastal Region are diked.

a. Freshwater Marsh. In freshwater marshes, some of the most desirable food plants are annuals which cannot maintain themselves on permanently flooded sites. These require moist or dry ground to grow and produce a good crop. They must be flooded in the fall in order to attract waterfowl. The seeds of many useful marsh plants germinate better when water levels are lowered until only a moist bed remains. Then, better aeration and higher temperatures stimulate germination of the seeds of many food plants that are difficult to establish when land is covered with water. This aeration also releases, by decomposition, nutrients that would remain bound up in submerged plant materials. Plants that are encouraged by this method of water control are smartweeds, wild millet, Asiatic dayflower, tearthumb, spikerushes, panic grasses, red root, rice cutgrass, and arrow-arum.

To encourage these plants, a late winter drawdown is required. This enables the soil to dry out sufficiently to either cultivate or, if possible, to burn before plants turn green in the spring. Once the soil has been either prepared mechanically or the old vegetation burned, the water level is raised even with the bed, but not ponding over the soil. An effort should be made to keep the water at this level during the growing season. If the soil is kept too dry during the growing season, plume grass, beggar ticks, tearthumb, wood awn-grass, foxtail grass, alder, and willow will dominate the plant community. These plants are of moderate value as waterfowl foods. If the impoundment is kept flooded during the growing season, then such undesirable plants as giant cutgrass, cattails, pickerelweed, alligator-weed, and even lotus and white water-lily are encouraged. In addition, manipulation of water level, fire, and mechanical disturbance of the soil are probably the most important management tools in freshwater marsh impoundments.

Specific objectives should be established before a marsh is burned. Normally the aims would be one or more of the following:

1. To set back plant succession from an undesirable climax or near-climax to a sub-climax plant community that will produce more waterfowl food.

2. To remove or open up dense growths of vegetation to a degree suitable for use as feeding areas by waterfowl.

3. To create ponds and open water areas in a dense marsh by burning into the marsh floor.

Burning helps to cultivate the marshland, and the marsh is fertilized by ash deposits left by fire. Marshes usually have a healthier appearance during regrowth following fire, partly because of the release of nutrients by burning. When and how to burn are important considerations. Healthy shallow water marshes in the final stages of plant succession sometimes produce vegetative cover too dense for winter use by ducks. A clean cover burn usually done in the fall or winter will produce an immediate change in the habitat because it removes all standing vegetation. Seldom, however, do marked changes in vegetative types result from a cover fire. Root burns are made when the marsh floor is dry and the water table is well below ground level. Such fire damages roots of plants and can change the types of vegetation. A hot root burn can reduce or remove climax vegetation, which generally is useless to waterfowl. A third type of burn involves an extremely dry marsh growing on a layer of dry peat. Marsh soils comprised mainly of organic materials from decaying plants will burn when dry enough. Small pot holes, ponds, and even large lakes can be created by means of peat burns.

Mechanical disturbance of the soil can be effective in setting back succession, creating openings for waterfowl feeding and resting areas or for preparing a seed bed for cultivated crops.

b. Brackish Marsh. The brackish marsh should be managed somewhat differently than the freshwater marsh for optimal production of waterfowl food plants such as widgeongrass, salt-marsh bulrush, and dwarf spikerush. As a matter of convenience, these marsh impoundments can be characterized as those that have water salinities of $1^{o}/oo$ or more.

In brackish marsh impoundments with salinities that normally range below $1^{o}/oo$, both emergents and submerged aquatic plants can be grown together. Quite often management is aimed as much at discouraging or eliminating undesirable plants as it is directed toward encouraging desirable food plants. A technique that has been successful in low salinity marshes is to de-water the impoundment in late February and keep the bed semi-dry through March. During this period, salt-marsh bulrush and dwarf spikerush will begin to grow. In the spring, the impoundment is re-flooded to a depth of 6 in (15.2 cm). Until late summer, water is added monthly in 6-in increments until a depth of about 2 ft (0.6 m) is reached. During this time, the salt-marsh bulrush and dwarf spikerush will continue to grow; widgeongrass will grow in the more open area.

Once a 2-ft (0.6 m) water level has been reached, it is desirable to keep water gradually moving through an intake structure, across the impoundment, and over a spillway. This helps to keep the salinity up and, by moving water through the impoundment, it will flush blooms of undesirable algae out which otherwise remain and limit sunlight penetration through the water. In late summer and early fall, plants such as wild millet, sprangle-top, and fall panic grass will be dominant along the shallow edges of the impoundment.

Often when these impoundments are kept dry, smooth cordgrass will become dominant and, once established, it may take several years to eliminate unless mechanical means are used. If an impoundment of this type is allowed to remain permanently flooded, the salinity will eventually be lowered and narrow-leaved cattail will dominate the salt-marsh bulrush as well as take over in the shallow margins. In the deeper open water areas, an algae called Cladophora will usually form solid mats that practically exclude other submerged aquatics.

Widgeongrass is one of the more desirable plant species found in brackish marsh impoundments. No single factor is more detrimental to the establishment or maintenance of stands of widgeongrass than water fluctuation. When water fluctuations are great and pond bottoms are periodically exposed, widgeongrass will not become established or, if established, the stand will quickly disappear. In large open ponds, wave action can be detrimental to stands of well-established widgeongrass. The establishment of wind breaks, either by encouraging natural stands of emergent vegetation or by the construction of some physical wave barrier, is helpful in this situation.

Another desirable type of submerged aquatic that grows well in brackish marsh impoundments is the nonvascular muskgrasses (Chara spp.). Large numbers of ducks can be attracted by this food plant. Muskgrass does best in salinities of 15°/oo or less. Muskgrass requires "hard" water as it becomes encrusted with calcium carbonate, and the continued presence of this type of plant from year to year may result in the deposition of considerable calcareous material upon the pond bottom. It does well where the water is clear and very poorly where the water is turbid.

Sago pondweed is a very valuable waterfowl food plant commonly found in hardwater lakes. Generally sago pondweed grows best in fresh water, but tuber production is at an optimum at about 3°/oo salinity. Sago plants show different tolerance to salt at different ages. For instance, 1 week old plants will tolerate 9°/oo but die at 12°/oo. Four week old plants will tolerate 12°/oo but die at 15°/oo, and 8 week old plants tolerate 15°/oo but die at 18°/oo.

A final management consideration concerning brackish marsh impoundments is associated with large populations of fish. In ponds that are kept fairly fresh from year to year, carp populations can become a problem. Carp, and sometimes mullet, can affect vegetation in at least three ways: a) by uprooting vegetation while searching for food, b) through consumption of plants for food, and c) by causing increased turbidity, which limits sunlight penetration, which in turn limits plant growth. Also, when these fish keep nutrients in suspension through rooting or otherwise digging up bottom sediments, heavy blooms of blue-green algae often result.

2. Hardwood Bottomlands

Hardwood bottomlands can be managed very successfully to attract waterfowl. Wood ducks, mallards, and black ducks can be attracted in a flooded hardwood bottom that has a good stand of mast-producing trees. Flooded hardwood bottomlands do not have to be of great size to be effective. Even small areas containing oaks, hickory, black gum, tupelo, sweet gum, and bald cypress will attract ducks when properly flooded.

The essentials for managing a hardwood bottomland area for waterfowl are suitable terrain and soil, a source of water, and mast-producing trees. The most suitable terrain is large expanses of flat land where a relatively inexpensive low dike can impound several inches of water over a large area. If such topography is not available, then a series of steps can be constructed to flood a series of smaller impoundments. An important consideration is to design the dikes low with a wide base to reduce damage to them when flood waters overflow them. The water control structures should be adequate to handle the volume of water in the drainage. The structure should be placed to permit an impoundment depth of from 1 to 15 in (2.5 - 76.2 cm), plus have the capability to permit the complete drainage of the area.

A dependable and adequate source of water is desirable. Storage reservoirs from which the bottomland can be flooded by gravity flow are ideal. Pumping is another method that allows water control; however, this method can be expensive when large acreages are involved. Pumping is sometimes useful in supplementing other sources of water.

The timing of flooding and drainage is important to the survival and vigor of mast-producing trees. Flooding can be started safely in the fall just as the leaves begin to turn color, but the area should be drained by the time the buds begin to swell in the spring. Complete drainage before the growing season is important, because summer flooding can damage or kill desirable mast species. The safe period of flooding extends from early October through February in the Sea Island Coastal Region.

Manipulation of water levels may help prevent depletion of the acorn crop by other species of wildlife before the waterfowl arrive in the fall. A periodic lowering of water levels during the fall and winter may prove necessary to obtain a more complete use of the acorns by ducks.

Quite often the stand of timber in a hardwood impoundment can be improved to have maximum value for waterfowl. The goal for waterfowl management should be to achieve a forest with a preponderance of vigorous, large-crowned, mast-producing species. Stagnated and slow growing stands of desirable trees should be thinned to give the crowns a chance to grow.

D. ECONOMIC CONSIDERATIONS OF WATERFOWL MANAGEMENT

Morgan (1974) and Morgan et al. (1975) reported on the biological and economic aspects of wetlands management within the Edisto-Ashepoo-Combahee drainage system along the coast of South Carolina. Of the 335,629 acres (135,827 ha) in the study area, 98,451 acres (39,842 ha) were wetlands. This included 1) 54,087 acres (21,889 ha) of undiked marsh and tidal swamp, 2) 21,828 acres (8,834 ha) of abandoned impoundments (98% of which were former rice fields), and 3) 22,536 acres (9,120 ha) of managed impoundments. Of the 213 impoundments, 154 (72%), totalling 19,064 acres (7,715 ha) (85%), were managed to attract waterfowl.

Capital investments and annual costs of managing diked impoundments for waterfowl were estimated. The following summarizes the results of this economic evaluation; refer to Morgan (1974) for further details.

1. Capital Investments

The initial investment involved in marsh management is the purchase of the marsh. Cost of marsh in the area varied widely, depending on the location, presence or absence of impoundments, relation to adjoining high ground, and total acreage involved. Estates are usually sold as a unit with no distinction being made between costs of marsh and high ground. Consequently, it is difficult to establish a market value for marshland alone. The major investment in developing diked impoundments is constructing the dikes and associated water control structures. Capital values for these investments were based on replacement costs.

a. Dikes. The cost of building an average sized dike (7 feet high, 12 feet wide at the top, and 30 feet wide at the base) was $1.65 per linear foot if built on stable soils. This was assuming no major problems occurred, and diking could proceed unimpeded. Usually 2 years after a dike was built, an additional "pass" was needed to bring the dike up to grade, at an additional cost of $1.25 per linear foot. An extra cost of $400 - $800 was often incurred when dikes were built across creeks or when broken dikes needed repair; the above estimate does not include these figures. Therefore, a conservative estimate of cost per linear foot is about $3.00. This low cost could only be met when the following conditions existed: good stable soils, absence of creek beds, and favorable weather conditions.

b. Other Water Control Structures. Drag-line operators and individuals who built water control structures were interviewed. Their cost figures and charges were used to calculate replacement costs for all water control structures in the study area.

Replacement costs of wooden water control structures, except very small and simple ones, were based on a "standard" size trunk (i.e., 2 feet high, 5 feet wide, and 36 feet long) with two flap gates and one flash-board riser. The replacement cost for this trunk was $2,290.

Metal water control structures were usually made of heavy gauge steel pipe with bronze flap gates. Replacement costs for most of these were based on a standard size trunk 36 inches in diameter and 36 feet long with two bronze flap gates and one flash-board riser. The cost of such a trunk was $1,460. Replacement costs for smaller, simpler trunks ranged from $395 to $875 each.

A replacement cost of $1,920 each for the 10 concrete water control structures in the study area was determined from cost lists of concrete pipe companies in the Charleston area.

2. Annual Costs

Questionnaires were sent to 23 of the 52 property owners. Fourteen returned these forms which provided various types of information on annual costs. The following estimates of annual costs are based on maintenance of dikes and other water control structures, habitat manipulations, and taxes. Only labor related directly to these operations is included; labor costs for mowing dike vegetation and for maintenance of access roads, barns, storage building, equipment and other indirect labor costs are not included, nor are costs of equipment not used solely for management of impoundments.

a. Maintenance of Dikes. Eleven of the 14 forms returned contained specific information relating to intervals between necessary dike retopping. The average interval for retopping was 6 years, with some landowners retopping at 2 years and others at 10 years. An average cost of $1.25 per linear foot for retopping is based on interviews with drag-line operators. Continually sinking dikes or numerous bad breaks ("blow-outs") would increase this cost considerably. Another factor in dike maintenance cost was mowing, but no estimate of this cost was made.

b. Maintenance of Other Water Control Structures. Cost records provided by six landowners indicated the actual cost of annual water control structure maintenance to be $72.00 each.

c. Habitat Manipulation. Nine of the returned forms contained details on annual cost of habitat manipulation within impoundments, including flooding, burning, water-level manipulation, disking, plowing, planting of commercial crops, cattle grazing, and herbicide application. Extremes of habitat management costs for these nine property owners ranged from $1.85 to $17.44 per acre per year ($4.57 to $43.09/ha/yr), with six reporting costs between $7 and $11 per acre ($17.30 and $27.18/ha). The average cost of annual habitat manipulation for privately managed areas was $8.25 per acre ($20.37/ha). The South Carolina Wildlife and Marine Resources Department spent an average of $8.44 per acre ($20.84/ha) for annual habitat maintenance of the Bear Island Game Management Area.

The annual cost of habitat management per acre of impoundment depended on the ecological situation, the intensity of management, management goals, and the amount of capital an owner is willing to invest to achieve his objectives. There were extreme variations in operational costs, and simple averages of management and maintenance costs are misleading. Each property had peculiarities that made it unique and the resulting costs varied.

d. Taxes. The tax assessor from each county in the study area furnished information on the 1973 land taxes, which was the same for undeveloped uplands and wetlands in the study area. The property tax for each 100 acres of wetlands was as follows: Charleston County--$11.56; Colleton County--$37.10; and Beaufort County--$5.10.

e. Summary of Management Costs. The unit costs, capital and annual, given above were used to construct a model cost table for 100 acres (40.5 ha) of diked impoundment over a 20-year period (Table 8-14). It should be emphasized that the values in Table 8-14 are averages, and actual costs varied greatly with the individual situation.

Based on an extrapolation of data in Table 8-14, total annualized cost for the 19,064 acres (7,715 ha) of diked impoundments managed for waterfowl was $516,846. From this figure and the estimated annual harvest of 11,438 ducks, the cost per duck harvested was $45. From the same cost figure and the 3,432 man-days of hunting previously calculated, the cost per man-day of hunting was $151. For those impoundments in which cattle were grazed, management costs may be reduced by the value of the grazing provided, based on appropriate rates for each grazing day.

The financial investment in the management of diked impoundments for the entire study area was large. Total replacement costs for all functioning dikes and water control structures in the area were calculated to be $2,048,774. Total annual costs of management of all diked impoundments were calculated to be $405,427, including $22,777 in property taxes.

Although the above economic evaluation is specific to the area studied and not necessarily characteristic of other coastal areas, it does provide an important evaluation of the costs associated with waterfowl management. Clearly, when lands under private, State, and Federal ownership are considered collectively, the capital and annual investments for waterfowl habitat management represent significant economic investments.

E. WATERFOWL POPULATION CHARACTERIZATION

Mid-winter surveys of waterfowl are of value in delineating species distribution patterns, in yielding a rough estimate of yearly change, and in providing reliable year-to-year population data. Mid-winter inventories for the 14-year period from 1964 to 1978 demonstrate the general trends of duck and goose populations in South Carolina and Georgia during that period (Figs. 8-3 and 8-4).

Table 8-14. Average cost of managing 100 acres of diked impoundment in the lower Edisto, Combahee, and Ashepoo drainage basins, South Carolina (Morgan 1974)[a].

Cost Category	Capital Cost[b]	Annual Cost	Total Capital and Annual Cost
Dike construction	$7,340	$ --	$ 748
Water control structures (wooden)	2,290	--	233
Maintenance			
dikes	--	764	764
water control structures	--	72	72
Habitat manipulation	--	852	852
Taxes (Colleton County)	--	37	37
Total	$9,630	$1,725	$2,706

a. Does not include costs of land, estate labor, facilities, and equipment which are primarily used in management of uplands.

b. Capital cost annualized at 8% for 20 years.

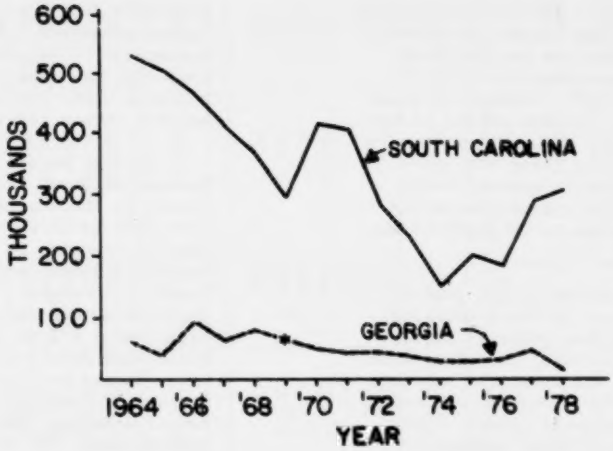

Figure 8-3. Mid-winter waterfowl population estimates for coastal South Carolina and Georgia (U.S. Department of Interior, Fish and Wildlife Service 1961 - 1978).

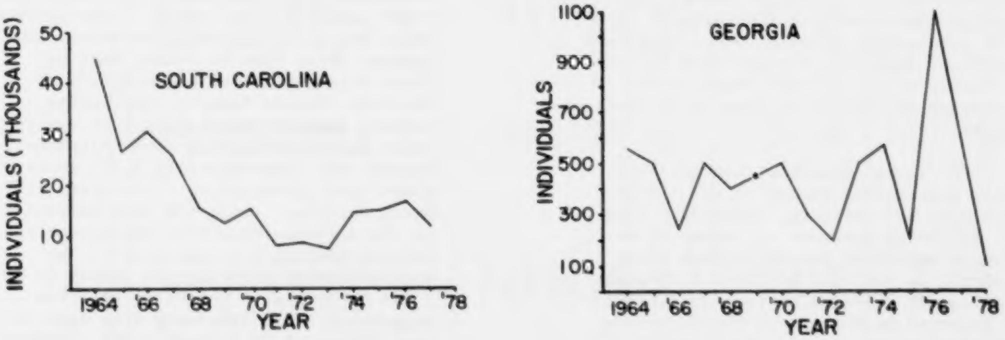

Figure 8-4. South Carolina and Georgia geese populations based on mid-winter surveys (U.S. Department of Interior, Fish and Wildlife Service 1961 - 1978).

During the 14-year period represented by these data, it is clear that coastal South Carolina consistently overwinters far more waterfowl than Georgia. On an annual basis, this averages out to mid-winter populations of waterfowl in South Carolina of approximately 340,000 to 52,000 in Georgia, or a ratio of 7:1. The data also reflect that mid-winter waterfowl populations for both States declined substantially from 1970 to 1974 and increased slightly between 1974 - 1978 (Fig. 8-3). Because of greater numbers of waterfowl, the decline noted in South Carolina is particularly evident and represents a decrease of 55% (526,000 to 288,000) for the 14-year period.

Although less abundant, the mid-winter population estimates for Canada geese show trends similar to those for other species of waterfowl (Fig. 8-4). For the period 1964 - 1977, the average Canada goose population in South Carolina was

18,000 as compared to 447 for Georgia, or a ratio of 40:1. The Canada goose population in South Carolina has declined from a high of approximately 44,000 in 1964 to 12,000 in 1977. Georgia's goose population during the same period of time declined from 550 to 100. Mid-winter population trends for these and other species of waterfowl in coastal South Carolina and Georgia during the period 1974 - 1978 are given in Tables 8-15 and 8-16.

The overall trends (e.g., greater numbers of waterfowl in South Carolina) between the two States probably reflect a combination of factors, including more available managed and unmanaged habitats and the more northern location of South Carolina in the Atlantic flyway. The trend of declines in total numbers of waterfowl for both States also is probably due to a combination of complex factors, including the general decline in the continental populations of waterfowl as a result of loss of critical wetland habitats, the effects of short-stopping waterfowl at higher latitudes in the flyways, and weather conditions.

F. WATERFOWL RESOURCE UTILIZATION

1. Harvest Characteristics

The number of waterfowl harvested annually in the United States has fluctuated widely as a result of changes in habitat conditions and fluctuations in fall populations of waterfowl. Long-term trends of waterfowl harvest were analyzed by Carney et al. (1975). Much of the following discussion is based upon their report.

The annual waterfowl harvest estimates reported by Carney et al. (1975) were made by combining information from the following sources: 1) sales of migratory waterfowl hunting stamps (duck stamps), as reported by the U.S. Postal Service; 2) averages of retrieved kill, as reported by hunters in the Service's Waterfowl Hunter Questionnaire Survey; and 3) numbers of wings or tails of each species received in the Service's Waterfowl Parts Collection Survey. Annual waterfowl regulations are set each summer and reflect the estimated size of that year's waterfowl populations. In 1962, a year of low waterfowl numbers and restrictive hunting seasons, approximately 4,250,000 ducks and 646,000 geese were harvested nationwide. In 1970, with increased populations and liberalized regulations, the harvest was estimated at over 15,900,000 ducks and 1,800,000 geese.

The impact of hunting upon migratory game birds is not well known because their mobility makes it difficult to assess the structure of discrete population segments throughout the year. However, data have shown that regulated harvest generally does not cause long-term population reduction. If sufficient habitats are available for overwintering and for breeding, most species are capable of bringing their populations back to preharvest levels (Bellrose 1976).

A large portion of the annual duck harvest in South Carolina and Georgia occurs in the coastal counties. Data from 1961 to 1970 indicate that the seven coastal counties in the Sea Island Coastal Region of South Carolina (Georgetown, Beaufort, Berkeley, Charleston, Colleton, Dorchester, and Jasper) accounted for approximately 47% of the diving ducks and 45% of the dabbling ducks harvested statewide (Tables 8-17 and 8-18). Waterfowl hunters in Georgia's coastal tier of counties during 1961 - 1970 accounted for approximately 20% of the dabbling ducks and 20% of the diving ducks harvested statewide (Tables 8-19 and 8-20). For these years (1961 - 1970), wood ducks and ringnecks were, respectively, the number one dabbling and diving ducks harvested in both States. When the State totals of harvested ducks were combined and compared with the overall harvest in the Atlantic flyway, the two-State area accounted for approximately 12% of the total dabbling ducks and 41% of the diving ducks harvested.

The annual harvest on State-controlled waterfowl management areas has been successful over the years, especially in South Carolina. In coastal South Carolina, there are six State-owned waterfowl management areas open to public hunting (Bear Island, Pee Dee, Santee-Cooper, Hatchery, Santee Reserve, and Santee Delta), whereas Georgia has just one State-owned waterfowl hunting area (Altamaha). During 1977, approximately 3,452 ducks and geese were harvested on these areas in South Carolina, while 458 were harvested in the Altamaha Waterfowl Management Area, Georgia (Tables 8-21 and 8-22). The species composition and the number of ducks harvested on the State waterfowl management areas fluctuate from year to year (Tables 8-23 through 8-26). Hunter success (ducks/gun) on the management areas also varied among years (Table 8-27).

2. Hunter Participation

Waterfowl hunting is an important recreational activity of thousands of sportsmen. The proportion of our population that hunts waterfowl varies between geographic areas, depending largely on the availability of waterfowl areas for hunting, suitable waterfowl habitat, and the density of human populations. Age, family income, and occupational distributions of waterfowl hunters are useful characteristics in predicting futures for the sport. In 1970, nearly half of the waterfowl hunters were 24 years old or younger and two-thirds were below age 35 (U.S. Department of Interior, Fish and Wildlife

Table 8-15. Results of mid-winter waterfowl surveys for coastal South Carolina, 1974 - 1978; statewide totals are presented in parentheses (U.S. Department of the Interior, Fish and Wildlife Service 1961 - 1978).

	Numbers of Individuals									
Species	1974		1975		1976		1977		1978	
Mallard	9,800	(44,300)	21,500	(64,000)	22,600	(77,200)	20,000	(112,600)	5,100	(103,400)
Black duck	2,900	(7,400)	4,400	(10,900)	5,100	(15,900)	5,500	(18,000)	1,200	(12,200)
Mottled duck	--	(tr)		(--)		(--)		(--)		(--)
Gadwall	3,000	(4,100)	4,000	(6,600)	3,300	(3,500)	8,900	(12,400)	2,200	(3,200)
American wigeon	5,600	(12,000)	9,800	(17,100)	7,900	(17,500)	3,800	(37,300)	8,200	(22,200)
Green-winged teal	24,300	(24,300)	28,200	(29,800)	15,400	(19,600)	25,400	(31,800)	8,800	(12,300)
Blue-winged teal	2,400	(2,400)	3,700	(3,800)	2,900	(3,500)	3,100	(3,700)	900	(2,500)
Shoveler	5,000	(5,100)	3,500	(3,700)	2,000	(3,500)	5,800	(8,800)	1,200	(1,900)
Pintail	13,200	(14,700)	26,600	(30,300)	12,000	(13,500)	17,600	(21,800)	15,200	(17,500)
Tree duck	tr	(tr)	--	(--)	tr	(-tr)	--	(--)	--	(--)
DABBLER TOTALS	66,200	(114,300)	101,700	(165,800)	71,200	(154,200)	90,100	(246,400)	42,800	(175,200)
Redhead	tr	(tr)	tr	(tr)	tr	(100)	100	(300)	tr	(600)
Canvasback	1,600	(1,600)	700	(700)	1,800	(1,800)	3,100	(3,400)	1,900	(2,000)
Scaup	800	(800)	1,200	(1,200)	1,300	(1,300)	2,800	(7,900)	2,100	(6,400)
Ring-necked duck	16,100	(17,500)	8,000	(8,600)	7,100	(11,300)	4,500	(15,300)	6,400	(8,600)
Common goldeneye	100	(100)	tr	(100)	tr	(100)	tr	(100)	tr	(tr)
Bufflehead	800	(800)	200	(300)	200	(500)	500	(1,600)	tr	(500)
Ruddy duck	1,300	(1,400)	1,400	(1,600)	1,100	(1,100)	1,000	(1,800)	100	(200)
DIVER TOTALS	20,700	(22,200)	11,500	(12,500)	11,500	(16,200)	12,000	(30,400)	10,500	(18,300)
Eiders	--	(--)	--	(--)	--	(--)	--	(--)	--	(--)
Scoters	300	(300)	300	(300)	800	(800)	--	(--)	tr	(tr)
Oldsquaw	100	(100)	--	(--)	tr	(tr)	--	(--)	200	(200)
SEA DUCK TOTALS	400	(400)	300	(300)	800	(800)	--	(--)	200	(200)
MERGANSERS	100	(100)	500	(500)	1,500	(2,000)	600	(1,600)	500	(1,900)
MISC. & UNIDENTIFIED	9,000	(15,300)	20,000	(24,800)	8,100	(13,900)	5,500	(9,700)	800	(1,700)
TOTAL ALL DUCKS	96,400	(152,300)	134,000	(203,900)	93,100	(187,100)	108,200	(288,100)	54,800	(197,300)

Table 8-15. Concluded.

Species	Numbers of Individuals									
	1974		1975		1976		1977		1978	
Snow goose	100	(100)	500	(500)	200	(200)	100	(100)	100	(100)
Blue goose	300	(300)	600	(700)	2,700	(2,700)	1,100	(1,000)	200	(200)
White-fronted goose	--	(--)	tr	(tr)	--	(--)	--	(--)	--	(--)
Canada goose	3,000	(14,000)	500	(13,800)	1,100	(13,800)	1,000	(12,100)	300	(5,900)
Black brant	--	(--)	--	(--)	--	(--)	--	(--)	tr	(tr)
TOTAL ALL GEESE	3,400	(14,400)	1,600	(15,000)	4,000	(16,700)	2,100	(13,200)	600	(6,200)
WHISTLING SWAN	tr	(tr)	18	(18)	28	(28)	27	(40)	tr	(tr)
COOT	26,000	(37,400)	21,200	(27,400)	14,000	(16,200)	15,400	(38,900)	91,000	(106,200)
TOTAL ALL WATERFOWL	125,800	(204,100)	156,800	(246,300)	111,100	(220,000)	125,700	(340,200)	146,400	(309,700)

Note: Wood ducks included among "Miscellaneous & Unidentified."
Final entries rounded to nearest 100.
"Tr" - less than 50 birds.
"--" - data not available.

Table 8-16. Results of mid-winter waterfowl surveys for coastal Georgia, 1974 - 1978; statewide totals are presented in parentheses (U.S. Department of the Interior, Fish and Wildlife Service 1961 - 1978).

Species	Numbers of Individuals									
	1974		1975		1976		1977		1978	
Mallard	733	(1,146)	700	(1,400)	2,300	(3,000)	1,000	(2,200)	1,500	(3,500)
Black duck	166	(221)	300	(400)	600	(600)	700	(800)	tr	(300)
Mottled duck	--	(--)	--	(--)	--	(--)	--	(--)	--	(--)
Gadwall	215	(480)	800	(1,600)	1,200	(2,900)	400	(800)	tr	(700)
American wigeon	399	(434)	400	(500)	400	(500)	400	(400)	500	(500)
Green-winged teal	180	(396)	400	(500)	1,100	(1,300)	200	(200)	100	(400)
Blue-winged teal	45	(45)	100	(100)	300	(400)	200	(200)	tr	(tr)
Shoveler	170	(170)	200	(200)	100	(100)	200	(300)	tr	(tr)
Pintail	45	(45)	100	(100)	700	(800)	tr	(100)	200	(200)
Tree duck	--	(--)	--	(--)	--	(--)	--	(--)	--	(--)
DABBLER TOTALS	1,953	(2,937)	3,000	(4,800)	6,700	(9,600)	3,300	(5,600)	2,300	(5,600)
Redhead	210	(210)	--	(--)	100	(100)	tr	(tr)	--	(--)
Canvasback	204	(204)	800	(800)	900	(900)	1,000	(1,000)	tr	(tr)
Scaup	21,735	(21,735)	9,600	(9,600)	10,700	(10,800)	39,300	(39,400)	2,500	(2,800)
Ring-necked duck	124	(349)	1,000	(1,200)	700	(1,800)	1,200	(1,600)	500	(1,800)
Common goldeneye	--	(--)	--	(--)	--	(--)	--	(tr)	tr	(tr)
Bufflehead	26	(26)	200	(200)	100	(100)	100	(100)	tr	(tr)
Ruddy	11	(11)	--	(--)	tr	(tr)	100	(100)	tr	(tr)
DIVER TOTALS	22,310	(22,535)	11,600	(11,800)	12,500	(13,700)	41,700	(42,200)	3,000	(4,600)
Eider	--	(--)	--	(--)	--	(--)	--	(--)	--	(--)
Scoter	3,300	(3,300)	5,200	(5,200)	11,500	(11,500)	tr	(tr)	6,300	(6,300)
Oldsquaw	--	(--)	--	(--)	--	(--)	--	(--)	--	(--)
SEA DUCK TOTALS	3,300	(3,300)	5,200	(5,200)	11,500	(11,500)	tr	(tr)	6,300	(6,300)
MERGANSERS	194	(196)	500	(500)	300	(300)	200	(200)	tr	(tr)
MISC. & UNIDENTIFIED	124	(342)	700	(1,600)	--	(200)	1,000	(1,100)	600	(1,400)
TOTAL ALL DUCKS	27,881	(29,310)	21,000	(23,900)	31,000	(35,300)	46,200	(49,100)	12,200	(17,900)

Table 8-16. Concluded.

Species	Numbers of Individuals 1974	 1975	 1976	 1977	 1978
Snow goose	1 (1)	-- (--)	-- (--)	tr (tr)	-- (--)
Blue goose	7 (9)	-- (--)	tr (tr)	tr (tr)	-- (--)
White-fronted goose	-- (--)	-- (--)	tr (tr)	-- (--)	tr (tr)
Canada goose	288 (564)	200 (200)	300 (1,100)	300 (600)	tr (tr)
Black brant	-- (--)	-- (--)	tr (tr)	-- (--)	100 (100)
					-- (--)
TOTAL ALL GEESE	296 (574)	200 (200)	300 (1,100)	300 (600)	100 (100)
WHISTLING SWAN	-- (--)	tr (tr)	-- (--)	-- (--)	-- (--)
COOT	1,155 (3,583)	7,700 (10,000)	4,900 (9,900)	2,900 (26,600)	3,300 (15,400)
TOTAL ALL WATERFOWL	29,332 (33,467)	28,900 (34,100)	36,200 (46,300)	49,400 (76,300)	15,600 (33,400)

Note: Wood ducks included among "Miscellaneous & Unidentified."
Final entries rounded to nearest 100.
"Tr" - less than 50 birds.
"--" - data not available.

Table 8-17. Distribution of average annual harvest of dabbling ducks in South Carolina during 1961 - 1970 (Carney et al. 1975).

County of Harvest	Mallard[a]	Black duck	Gadwall	American wigeon	Green-winged teal	Blue-winged teal	Northern shoveler	Pintail	Wood duck	Total Dabblers
Beaufort	2,012	1,016	980	1,131	807	162	152	103	863	7,226
Berkeley	1,605	1,484	771	1,124	1,807	29	204	97	1,268	8,449
Charleston	1,067	846	1,355	1,144	981	245	264	279	978	7,159
Colleton	1,364	608	895	593	649	85	400	346	686	5,426
Dorchester	16	16	8	2	151	27	27	--	280	527
Georgetown	1,120	521	384	514	1,547	139	169	446	2,735	7,575
Jasper	158	80	57	38	5	--	32	--	569	939
TOTAL	7,342	4,571	4,450	4,346	5,937	687	1,308	1,271	7,379	37,301
STATEWIDE TOTAL	20,139	8,972	5,788	5,913	8,077	804	1,712	1,540	31,407	84,359

a. Includes hand-reared and hybrids.
"--" - Data not available.

Table 8-18. Distribution of average annual harvest of diving ducks in South Carolina during 1961 - 1970 (Carney et al. 1975).

County of Harvest	Redhead	Canvasback	Greater scaup	Lesser scaup	Ring-necked duck	Common goldeneye	Bufflehead	Ruddy duck	Oldsquaw	Hooded merganser	Red-breasted merganser	Common merganser	Total Divers	All Species
Beaufort	60	11	18	263	371	17	67	--	--	362	--	27	1,196	8,422
Berkeley	62	20	53	241	553	20	68	49	--	204	25	--	1,295	9,744
Charleston	13	34	74	649	718	28	188	63	--	226	83	--	2,076	9,235
Colleton	--	14	13	61	261	--	21	--	--	19	2	--	391	5,817
Dorchester	--	--	--	6	7	--	2	--	--	15	--	--	30	557
Georgetown	--	182	32	143	220	19	37	50	9	46	37	--	775	8,350
Jasper	19	13	--	15	78	--	--	--	--	21	--	--	146	1,085
TOTAL	154	274	190	1,378	2,208	84	383	162	9	893	147	27	5,909	43,210
STATEWIDE TOTAL	199	287	294	1,659	3,856	153	708	273	9	1,728	166	27	9,359	93,718

Note: "--" - data not available.

County of Harvest	Mallard[a]	Black duck	Gadwall	American wigeon	Green-winged teal	Blue-winged teal	Northern shoveler	Pintail	Wood duck	Fulvous tree duck	Total Dabblers
Bryan	37	47	11	--	23	--	17	--	45	--	171
Camden	76	88	--	29	101	--	50	--	92	--	436
Chatham	426	291	136	98	207	36	7	29	490	--	1,720
Glynn	51	29	29	21	158	22	--	7	249	--	566
Liberty	31	19	60	33	58	--	--	15	219	--	435
Long	--	--	--	--	--	--	--	--	39	--	39
McIntosh	382	268	164	92	745	50	132	200	342	10	2,385
TOTAL	994	742	400	273	1,292	108	206	251	1,476	10	5,752
STATEWIDE TOTAL	5,344	1,682	929	690	1,972	121	283	301	16,714	10	28,496

a. Includes hand-reared and hybrids.
Note: "--" - data not available.

Table 8-20. Distribution of average annual harvest of diving ducks in Georgia during 1961 - 1970 (Carney et al. 1975).

County of Harvest	Redhead	Canvasback	Greater scaup	Lesser scaup	Ring-necked duck	Common goldeneye	Bufflehead	Ruddy duck	Oldsquaw	Surf scoter	Hooded merganser	Red-breasted merganser	Common merganser	Total Divers	All Species
Bryan	--	--	--	--	12	--	--	--	--	--	6	--	--	18	189
Camden	6	--	--	--	--	--	6	--	--	--	13	--	--	13	461
Chatham	--	21	20	190	89	7	--	--	--	--	58	--	--	58	2,105
Glynn	--	6	56	210	113	--	--	--	--	--	18	19	--	422	988
Liberty	--	--	--	33	24	--	17	--	--	--	47	--	--	121	556
Long	--	--	--	--	--	--	--	--	--	--	--	--	--	--	39
McIntosh	15	37	22	359	246	9	30	--	--	--	59	42	--	819	3,20[illegible]
TOTAL	21	64	98	792	484	16	53	--	--	--	201	61	--	1,790	7,542
STATEWIDE TOTAL	87	64	213	1,291	5,331	54	243	64	--	8	987	73	--	8,355	36,851

Note: "--" - data not available.

Table 8-21. Waterfowl harvest composition from all South Carolina Wildlife and Marine Resources Department waterfowl management areas (statewide) during 1976-77 (Strange 1977).

Species	Number	Percent
Green-winged teal	652	18.88
Mallard	602	17.43
Gadwall	436	12.63
American wigeon	414	11.99
Pintail	388	11.23
Ring-necked duck	245	7.09
Blue-winged teal	139	4.02
Shoveler	129	3.73
Black duck	120	3.47
Wood duck	90	2.60
Bufflehead	70	2.02
Hooded merganser	43	1.24
Ruddy duck	33	.95
Canvasback	32	.92
Redhead	24	.69
Scaups	21	.60
Mottled duck	04	.11
Canada goose	03	.08
Common goldeneye	03	.08
Blue goose	02	.05
Hybrid	02	.05
Snow goose	01	.02
TOTAL	3,452	99.88

Service 1972). Over half of the waterfowl hunters had family incomes of less than $10,000 per year. A third had annual incomes of less than $7,500. Nearly half of the total waterfowl hunters in the Nation were either craftsmen or operatives, 15% were professional or technical people, and only 4% were farmers (U.S. Department of Interior, Fish and Wildlife Service 1972). Nationally, the nearly 2.9 million waterfowl hunters in 1970 spent about $245 million on their sport, or $84 per person and nearly $10 per day that they hunted.

A postal survey, conducted by Webb (1976), was designed to determine the extent that licensed hunters in South Carolina utilized wildlife resources. This questionnaire obtained information on the number of hunting license holders that participated in the hunting of each game species and the utilization of game management areas versus nongame management areas for hunting. An estimated 49,694 hunters participated in duck hunting in South Carolina during 1975-76 (Table 8-28), as compared to 27,959 and 33,150 hunters during 1963-64 and 1966-67, respectively (Webb 1976).

The sale of "duck stamps" in South Carolina during the calendar year that initiated each of the involved waterfowl seasons was as follows: 21,001 sold in 1975, 14,916 sold in 1966, and 10,541 sold in 1963. It is assumed that most of the stamps were sold before or during the first part of each season. Data regarding goose hunting were not requested in the 1975-76 postal survey, but it is believed that the limited amount of goose hunting, as reported in 1963-64 and 1966-67, could not have accounted for the consistent discrepancies between the estimated duck hunters and the corresponding sale of stamps that are required for legal hunting of all migratory waterfowl (Webb 1976).

The Migratory Bird Hunting Stamps, commonly called "duck stamps," have been in existence since 1934. These stamps have provided millions of dollars which have been used exclusively to propagate ducks and geese in the United States. According to the U.S. Fish and Wildlife Service, revenue accrued from duck stamp sales in the 39 years of the program totals more than $125 million. This money has bought our national wildlife refuges which are "strategically located" in each of the four flyways utilized annually by migrating waterfowl. As birds migrate southward each winter, they find in these refuges a place to rest where they will not be disturbed by hunters. In the northern States, waterfowl refuges provide sanctuary for nesting birds. Tables 8-29 and 8-30 summarize duck stamps sold by counties within the study area during the years 1966-67 through 1975-76. Figure 8-5 illustrates how the waterfowl harvest surveys are conducted throughout the major flyways.

Table 8-22. Annual waterfowl harvest in the Altamaha Waterfowl Management Area, Georgia, for the period 1965 - 1979 (Georgia Department of Natural Resources, 1979, Atlanta, unpubl. data).

Species Date	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	Total
Mallard	11	17	16	22	20	50	26	31	21	44	23	46	12	339
Black	2	2	2	2	2	1	--	2	--	4	2	1	--	20
Pintail	7	14	14	2	2	26	9	3	12	12	19	9	3	134
Gadwall	13	—	8	--	43	2	13	13	11	25	9	8	1	146
Shoveler	9	3	31	13	64	21	29	22	22	64	51	33	3	365
American wigeon	5	16	25	--	32	6	9	5	23	49	11	2	—	183
Blue-winged teal	5	2	11	2	12	25	18	67	46	78	100	42	15	423
Green-winged teal	16	25	221	241	159	207	188	115	80	206	197	116	42	1,813
Wood duck	45	18	38	9	8	15	24	173	28	205	43	14	14	634
Canvasback	1	5	2	--	2	1	--	--	--	--	1	--	--	12
Redhead	2	5	1	--	1	1	2	--	--	--	1	5	1	19
Greater scaup	4	13	10	--	4	--	2	--	1	--	--	--	--	34
Lesser scaup	3	295	182	2	45	4	23	1	10	20	9	8	178	780
Ring-necked duck	16	8	43	11	8	15	21	9	9	25	64	35	24	288
Common goldeneye	1	1	--	--	1	--	--	--	--	--	--	--	1	4
Bufflehead	—	2	1	--	--	--	--	1	--	--	2	1	3	10
Hooded merganser	3	1	14	2	—	7	6	3	3	--	1	2	7	49
American merganser	7	2	4	--	1	—	--	2	3	--	2	—	--	21
Ruddy duck	2	2	1	--	5	1	--	10	--	1	15	5	1	43
Fulvous tree duck	—	8	--	1	--	--	--	--	5	--	--	--	1	15
American coot	--	6	174	47	66	76	--	--	--	--	215	131	34	749
Other	--	--	--	--	32	--	--	--	274	--	--	--	5	311
Totals	152	445	798	354	509	458	370	457	548	733	765	458	345	
GRAND TOTAL														6,392

Note: "--" - data not available.

Table 8-23. Waterfowl harvest composition on the Pee Dee Game Management Area during 1973 through 1977 hunting seasons (Strange 1977).

Species	HUNTING SEASONS							
	1973-74		1974-75		1975-76		1976-77	
	Number Killed	% Total Kill	Number Killed	% Total Kill	Number Killed	% Total Kill	Number Killed	% Total Kill
Green-winged teal	306	36.7	225	30.4	135	31.9	245	34.8
Wood duck	234	28.1	163	22.0	127	30.0	62	8.8
Mallard	98	11.8	147	19.9	35	8.2	139	19.8
Pintail	28	3.4	57	7.7	16	3.7	90	12.8
Shoveler	63	7.6	35	4.7	15	3.5	21	2.9
Ring-necked duck	39	4.7	22	3.0	19	4.5	44	6.3
American wigeon	17	2.0	24	3.2	31	7.3	14	1.9
Black duck	13	1.6	30	4.1	6	1.4	23	3.3
Gadwall	6	0.7	9	0.9	4	0.9	21	2.9
Canvasback	--	--	--	--	--	--	15	2.1
Blue-winged teal	14	1.7	12	1.6	11	2.6	9	1.3
Hooded merganser	14	1.7	6	0.8	4	0.9	6	.8
Ruddy duck	1	0.1	7	0.8	1	0.2	4	.6
Lesser scaup	--	--	2	0.3	11	2.6	2	.3
Redhead	1	0.1	--	--	--	--	3	.4
Bufflehead	3	0.4	1	0.1	--	--	3	.4
Common goldeneye	--	--	--	--	--	--	1	.1
Fulvous tree duck	--	--	--	--	6	1.4	--	--
Hybrid	2	6.2	--	--	1	0.2	2	.3
TOTALS	850	100.0	740	100.0	442	99.3	703	99.8

Note: "--" - data not available.

Table 8-24. Waterfowl harvest composition on the Santee-Cooper Game Management Area during the 1973 through 1977 hunting seasons (Strange 1977).

Species	HUNTING SEASONS							
	1973-74		1974-75		1975-76		1976-77	
	Number Killed	% Total Kill	Number Killed	% Total Kill	Number Killed	% Total Kill	Number Killed	% Total Kill
Gadwall	17	11.2	35	23.6	61	39.1	28	20.3
American wigeon	16	10.5	45	30.4	32	20.5	28	20.3
Mallard	46	30.3	10	6.8	7	4.5	20	14.5
Hooded merganser	17	11.2	26	17.7	23	14.7	8	5.8
Wood duck	16	10.5	13	8.8	4	2.6	9	6.5
Green-winged teal	12	7.9	9	6.1	17	10.9	31	22.5
Black duck	4	2.6	4	2.7	3	1.9	3	2.2
Ring-necked duck	15	9.9	1	0.6	1	0.7	8	5.8
Pintail	3	1.9	--	--	1	0.7	--	--
Shoveler	1	0.7	3	2.0	2	1.3	--	--
Lesser scaup	1	0.7	--	--	2	1.3	--	--
Blue-winged teal	--	--	2	1.3	--	--	--	--
Bufflehead	--	--	--	--	--	--	--	--
Redhead	--	--	--	--	--	--	2	1.4
Canada goose	4	2.6	--	--	3	1.9	1	.7
							--	--
TOTALS	152	100%	148	100%	156	100%	138	100%

Note: "--" - data not available.

Table 8-25. Waterfowl harvest composition on the Hatchery Game Management Area during the 1974 through 1977 hunting seasons (Strange 1977).

Species	HUNTING SEASONS					
	1974-75		1975-76		1976-77	
	Number Killed	% Total Kill	Number Killed	% Total Kill	Number Killed	% Total Kill
Gadwall	53	14.2	30	9.9	3	.71
American wigeon	77	20.6	21	6.9	33	7.83
Mallard	43	11.5	75	24.8	105	24.94
Hooded merganser	2	0.5	1	0.3	--	--
Green-winged teal	42	11.3	11	3.6	13	3.08
Black duck	2	0.5	15	5.0	--	--
Ring-necked duck	105	28.2	68	22.5	66	15.67
Pintail	15	4.1	15	5.0	18	4.27
Shoveler	1	0.3	4	1.3	65	15.43
Lesser scaup	9	2.4	6	2.0	2	.47
Blue-winged teal	2	0.5	19	6.3	6	1.42
Bufflehead	--	--	2	0.7	8	1.90
Ruddy duck	1	0.3	7	2.3	--	--
Redhead	21	5.6	28	9.3	65	15.43
Mottled duck	--	--	--	--	22	5.22
Canvasback	--	--	--	--	1	.23
Blue goose	--	--	--	--	--	--
Snow goose	--	--	--	--	14	3.32
Canada goose	--	--	--	--	--	--
TOTALS	373	100%	302	100%	421	99.92%

Note: "--" - data not available.

Table 8-26. Waterfowl harvest composition on the Bear Island Game Management Area during the 1973 through 1977 hunting seasons (Strange 1977).

Species	HUNTING SEASONS							
	1973-74		1974-75		1975-76		1976-77	
	Number Killed	% Total Kill	Number Killed	% Total Kill	Number Killed	% Total Kill	Number Killed	% Total Kill
Gadwall	40	5.60	71	7.8	82	9.0	104	10.01
American wigeon	--	--	122	13.4	47	5.0	90	8.67
Mallard	33	3.89	46	5.1	73	8.0	178	17.14
Hooded merganser	13	1.53	--	--	14	2.0	23	2.21
Wood duck	8	0.94	4	.4	1	.1	3	.28
Green-winged teal	279	32.92	178	19.6	284	31.0	257	24.75
Black duck	22	2.59	19	2.1	45	5.0	35	3.37
Ring-necked duck	227	26.74	318	34.7	199	22.0	120	11.56
Pintail	24	3.36	42	4.6	18	2.0	61	5.87
Shoveler	34	4.76	36	4.0	37	4.0	31	2.98
Lesser scaup	33	4.01	10	1.1	2	.2	4	.38
Blue-winged teal	86	10.15	58	6.4	107	12.0	104	10.01
Bufflehead	6	0.71	4	.4	3	.3	--	--
Ruddy duck	9	1.26	5	.6	3	.3	7	.67
Redhead	--	--	--	--	1	.1	17	1.63
Mottled duck	--	--	--	--	--	--	--	--
Canvasback	--	--	--	--	--	--	2	.19
Baldpate	27	3.78	--	--	--	--	--	--
Common goldeneye	3	0.42	--	--	--	--	2	0.19
Oldsquaw	1	0.11	--	--	--	--	--	--
Unidentified	--	--	1	.1	--	--	--	--
TOTALS	845	100%	914	100%	916	100%	1,038	99.9%

Note: "--" - data not available.
Baldpate = American wigeon

Table 8-27. Waterfowl harvest and hunter success on South Carolina Game Management Areas 1969 - 1976 (Strange 1976).

Year	Area	Hunters	Harvest	Ducks/Gun
1969	Bear Island	678	1,735	2.56
	Pee Dee	277	436	1.57
1970	Bear Island	332	977	2.94
	Pee Dee	319	495	1.55
1971	Bear Island	515	1,271	2.47
	Pee Dee	299	479	1.60
1972	Bear Island	510	552	1.08
	Pee Dee	333	679	2.04
1973	Bear Island	460	845	1.80
	Pee Dee	311	850	2.73
	Santee-Cooper	101	152	1.50
1974	Bear Island	437	914	2.09
	Pee Dee	326	740	2.26
	Santee-Cooper	109	148	1.36
	Hatchery	246	372	1.45
	Santee Reserve	258	1,038	4.22
1975	Bear Island	403	916	2.27
	Pee Dee	316	422	1.34
	Santee-Cooper	77	154	2.00
	Hatchery	316	302	.96
	Santee Reserve	297	1,143	3.85
1976	Bear Island	423	1,038	2.45
	Pee Dee	316	704	2.23
	Santee-Cooper	81	138	1.70
	Hatchery	396	423	1.07
	Santee Reserve	260	1,061	4.08
	Santee-Delta	120	89	.74

Total All Game Management Areas - Hunters - 1,336
Harvest - 2,392
Shells - 11,478
Ducks/Gun/Day - 1.79
Shells/Duck - 4.80

The 1975-76 survey data show that most of the duck hunting, harvest, and man-days of such hunting were realized from nonmanagement areas (Table 8-28). This was expected, as the game management program in South Carolina includes a relatively small amount of waterfowl shooting areas.

The survey data also show that the harvest of ducks during 1975-76 on management areas was 1.6 ducks per man-day of hunting, whereas, the harvest per man-day on nonmanagement areas was 1.7 ducks per man-day (Table 8-28). These "harvest per man-day of hunting data" differ somewhat from those reported elsewhere. For example, data included in the South Carolina "Waterfowl Status Report of 1975-76" (Strange 1976) noted that the duck harvest/man-day on management areas was 1.6 ducks. These specific kill/man-day data are thought to be fairly accurate as hunters were checked as they left the controlled State waterfowl shooting areas (management areas). The 1.6 ducks/man-day reported by Strange agrees with the 1.6 kill/man-day on management areas reported by Webb (1976) (Table 8-28). At the same time, however, the statewide duck kill per man-day of hunting was reported by the U.S. Department of Interior, Fish and Wildlife Service (1976) as being 0.94 ducks. This latter kill figure is much less than the statewide kill per man-day of 1.7 ducks shown in Table 8-28. Neither Strange (1976) nor the U.S. Department of Interior, Fish and Wildlife Service (1976)

Table 8-28. Estimated number of duck hunters, number of ducks harvested, and number of days spent hunting in South Carolina during 1975-76, stratified by game management and nongame management areas[a], with the average number of ducks harvested per man-day of hunting in 1975-76 as compared to 1966-67 and 1963-64 surveys (± data relate to 95% confidence intervals) (Webb 1976).

Species	Type of Area	Hunters	Harvest	Days	Avg. No. Game Killed Per Man-Day Hunted[b]		
					1975-76	1966-67	1963-64
Ducks	Management Area	9,301(±12,080)	71,370(± 44,338)	45,176(±16,341)	1.58		
	Nonmanagement Area	38,722(±11,162)	420,057(±104,652)	247,708(±36,687)	1.70		
	Statewide Total[c]	46,694(±10,900)	491,427(±113,654)	292,884(±40,049)	1.68	1.34	1.01

a. Sample size relating to these species was insufficient for stratification by types of licenses.

b. Data on kill per man-day obtained only on total game harvest for some species in 1966-67 and 1963-64 surveys, with several species not included in the previous surveys.

c. Statewide total number of hunters includes only once the number of hunters that hunted each species on both management and nonmanagement areas, while the harvest and man-days hunted data for each species are actual totals from hunting on both types of areas.

Table 8-29. Duck stamps sold in South Carolina, by county, during 1966-67 through 1975-76 seasons (Carney et al. 1977).

County	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
Georgetown	768	772	750	952	1068	1104	907	974	1071	1159
Berkeley	569	467	581	713	814	790	705	734	760	809
Dorchester	310	291	328	349	341	352	302	299	325	358
Colleton	401	450	505	542	508	492	435	422	468	462
Jasper	279	296	178	333	242	271	266	240	251	240
Beaufort	238	147	154	249	543	392	351	330	335	425
Charleston	1684	2021	2610	2719	3044	2721	2339	2122	2249	2151
TOTALS	4249	4444	5106	5857	6560	6122	5305	5121	5459	5604

Table 8-30. Duck stamps sold in Georgia, by county, during 1966-67 through 1975-76 seasons (Carney et al. 1977).

County	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
Chatham	739	1041	223	1175	1313	1036	1018	954	921	922
Bryan	38	51	39	46	62	70	47	66	62	55
Liberty	52	64	88	129	138	91	105	107	70	24
McIntosh	120	127	126	112	105	94	94	97	117	107
Glynn	313	104	343	369	374	372	299	--	266	282
Camden	32	18	32	15	28	44	23	27	26	18
TOTALS	1294	1405	851	1846	2020	1707	1586	1251	1462	1408

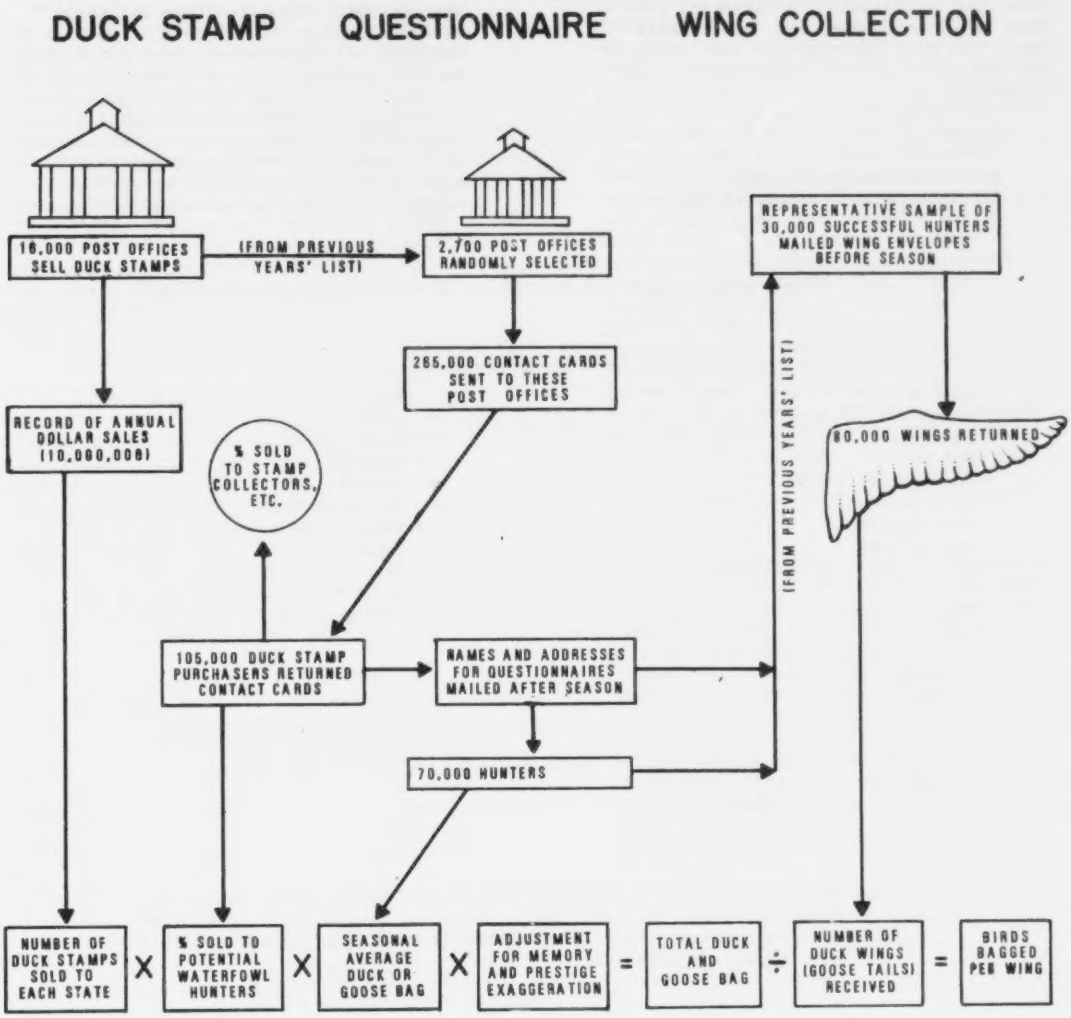
DUCK STAMP
QUESTIONNAIRE
WING COLLECTION
16,000 POST OFFICES SELL DUCK STAMPS
(FROM PREVIOUS YEARS' LIST)
2,700 POST OFFICES RANDOMLY SELECTED
265,000 CONTACT CARDS SENT TO THESE POST OFFICES
RECORD OF ANNUAL DOLLAR SALES (10,000,000)
% SOLD TO STAMP COLLECTORS, ETC.
REPRESENTATIVE SAMPLE OF 30,000 SUCCESSFUL HUNTERS MAILED WING ENVELOPES BEFORE SEASON
(FROM PREVIOUS YEARS' LIST)
80,000 WINGS RETURNED
105,000 DUCK STAMP PURCHASERS RETURNED CONTACT CARDS
NAMES AND ADDRESSES FOR QUESTIONNAIRES MAILED AFTER SEASON
70,000 HUNTERS
NUMBER OF DUCK STAMPS SOLD TO EACH STATE
X
% SOLD TO POTENTIAL WATERFOWL HUNTERS
X
SEASONAL AVERAGE DUCK OR GOOSE BAG
X
ADJUSTMENT FOR MEMORY AND PRESTIGE EXAGGERATION
=
TOTAL DUCK AND GOOSE BAG
÷
NUMBER OF DUCK WINGS (GOOSE TAILS) RECEIVED
=
BIRDS BAGGED PER WING

Figure 8-5. Schematic of annual waterfowl harvest surveys conducted by the U.S. Fish and Wildlife Service (Carney et al. 1975).

present any specific kill/man-day data for nonmanagement areas.

II. UPLAND GAME RESOURCES

This section presents a discussion of the game species found in the Sea Island Coastal Region, their food habits, cover requirements, limiting factors, and utilization by man. However, no attempt has been made in this section to present a text on game management techniques. The reader may notice some overlap between the biological sketches presented in this section and certain materials presented in Volume III. As with the waterfowl section, this material is more easily understood and appreciated when organized as a unit rather than diffused throughout various habitats. For information on functional interactions, one should refer to Volume III.

Accurate estimates of wildlife population trends within coastal counties of both States are difficult to ascertain. Most figures are compiled from hunter-kill data and are subject to variations in season length, weather, harvest methods, weapons used, and in the attitudes of hunters reporting the kills. In addition, data summaries in many cases have not been consistently analyzed by discrete areas.

Summaries by statewide, geographic, game zone, management area, and county basis have often been superimposed and trends are difficult, if not impossible, to interpret.

A. HUNTING

Controlled hunting is one of the most flexible tools of wildlife management. When properly regulated, hunting keeps wildlife populations in check. South Carolina and Georgia have some of the best hunting and most liberal harvest limits in the Southeast. Game animals reported by both States are presented in Table 8-31. Table 8-32 presents the projected number of licensed hunters that hunted game species in South Carolina, by species hunted. The species are ranked by hunter

Table 8-31. Upland game animals and furbearers of South Carolina and Georgia.

- Bobcat[a]
- White-tailed deer
- Bobwhite
- Raccoon
- American woodcock
- Wild turkey
- Gray squirrel
- Fox squirrel
- Gray fox[a]
- Red fox[a]
- Mourning dove
- Rabbits
  - Eastern cottontail
  - Swamp rabbit
  - Marsh rabbit
- Marsh hen (Clapper rail)
- Beaver[a]
- Mink[a]
- Opossum
- Otter[a]
- Ruffed grouse
- American coot
- Feral hog[b]
- Crow
- Black bear[c]
- Common snipe

a. Furbearers sold commercially in both States.
b. Records kept only in Georgia.
c. Hunted only in South Carolina.

Table 8-32. Projected number of licensed hunters that hunted game species in South Carolina, 1975-76. Projections based on a total of 210,504 license holders. Species are ranked according to hunter participation (Webb 1976).

Wildlife Species	Total Number Hunters	Percent of Total Licensed Hunters
Total Deer	103,639	49.2
Buck deer	101,930	48.4
Doe deer	34,546	16.4
Mourning dove	103,259	49.1
Bobwhite	77,634	36.9
Total Squirrel	77,444	36.8
Gray squirrel	74,407	35.3
Fox squirrel	14,236	6.8
Rabbit	63,018	29.9
Waterfowl	46,694	22.2
Raccoon	23,347	11.1
Wild turkey	9,111	4.3
Opossum	8,542	4.1
Snipe	7,782	3.7
Woodcock	7,403	3.5
Marsh hen (Clapper rail)	5,505	2.6
Gray fox	4,935	2.3
Red fox	2,657	1.3
Bobcat	2,657	1.3
Bear	1,519	0.7

participation. Deer and dove were the most sought after species, with hunter participation of 49.2% and 49.1%, respectively. In Georgia, deer is the overwhelming favorite with 72.5% of the hunters seeking deer (Table 8-33). The major differences in game species between the two States are that the black bear is hunted only in South Carolina and feral hog harvest records are maintained only in Georgia. Tables 8-32 and 8-33 present the projected number of licensed hunters that hunted game species in South Carolina (1975-76) and Georgia (1977-78), respectively.

1. White-tailed Deer

The white-tailed deer is a major wildlife resource in coastal South Carolina and Georgia. With the possible exception of waterfowl, deer attract more public interest, support the largest upland game recreational industry, and contribute the greatest economic burden to agriculture and forestry of any game species in the coastal counties. It is unfortunate that more long-term data pertaining to deer are not available on a local rather than regional basis.

When European settlers arrived in the Southeast, deer were abundant everywhere. Venison, buckskin, and deer-bone tools played an integral part in the lives of North American Indians for untold generations. Although the Indians used a number of ingenious and successful techniques to hunt deer, it was not until the arrival of Europeans that the species was threatened. European settlers, resenting restrictions on the hunting of game levied by European nobility, considered deer public property and hunted them for food, clothing, and profit. Thus, at a time when increasing numbers of small agricultural openings should have favored increasing deer populations, increased hunting pressure was decimating their ranks. The economic importance of deer and concern over their decline were so great that "by the end of the colonial period, all colonies except Georgia had enacted closed season laws for its protection" (Young 1956). By the late 1800's, however, expansion of agriculture and continued heavy hunting had virtually exterminated deer over most of the eastern United States. In South Carolina by the early 1900's (Moore 1978) and in Georgia by 1920 (Jenkins 1953), deer herds had reached all time lows. Deer restocking and relocation programs in both States enabled deer populations to make comebacks.

a. Limiting Factors. Although deer may be observed in virtually any habitat type represented along the coast, it is clear that they prefer to inhabit and are most prolific in areas characterized as "edges" (Severinghaus and Cheatum 1956), areas interspersed with various categories of natural habitats and/or agricultural and recreational lands. An interspersion of brushland, woodland, and nonforested land creates more diversity in types and amounts of food and cover present. Deer and other wildlife species utilize "edges" heavily. Many timber

Table 8-33. Projected number of licensed hunters that hunted game species in Georgia, 1977-78. Projections are based on a total of 284,174 license holders. Species are ranked according to hunter participation (Odom and Daws 1978).

Wildlife Species	Total Number Hunters	Percent of Total Licensed Hunters
Deer	206,083	72.5
Mourning dove	126,855	44.6
Squirrel (fox and gray)	106,338	37.4
Bobwhite	75,590	26.6
Rabbit	66,724	23.5
Raccoon	24,098	8.5
Waterfowl	20,404	7.2
Wild hog	16,084	5.7
Crow	12,134	4.3
Opossum	10,259	3.6
Fox (gray and red)	6,621	2.3
Woodcock	5,882	2.1
Wild turkey	5,229	1.8
Grouse	5,087	1.8
Bobcat	4,831	1.7
Marsh hen (Clapper rail)	1,591	0.6
Coot	1,535	0.5

harvest operations today create this "edge effect" and add diversity to forest habitats. The following discussion of management for increased deer production is taken from Moore (1978).

Pure stands of pine trees generally provide poor deer habitat because of the low quality of forage occurring there and the scarcity of mast-producing hardwoods. Dense stands and closed canopies reduce browse and fruit yields. Primary management efforts for increased deer production in this forest type should be directed toward increasing browse production. Intermediate thinning of these pine stands is recommended to open overstory and encourage desirable understory vegetation. Thinning should be sufficient to achieve a basal area of 50 to 60 ft^2/acre (1.9 - 2.2 m^2/ha) prior to stand regeneration.

Pine-hardwood forests generally provide good deer habitat and are important for mast, fruit, and browse production. These stands should be thinned frequently to lower limits of tree stocking, to renew understory forage, and to hasten early mast yields. Where possible, retention of the valuable hardwood mast component is recommended. A minimum stocking equivalent of 20 ft^2/acre (0.8 m^2/ha) basal area of mast species is suggested. A good balance between white and red oak species groups is desired to provide consistent mast production.

The bottomland hardwood forest type containing oak, gum, and ash provides good deer habitat. These areas normally have fertile soils and provide high quality browse; however, they are often subject to flooding which may somewhat reduce available food supplies. Mast production in this habitat is generally good but, as in the mixed pine-hardwood type, both white and red oak species groups should be retained.

Deer have a large and varied diet and eat practically all vegetative species. Twigs, leaves, bark, and such herbaceous material as grasses, weeds, and soft-stemmed plants are important in their diets. Acorns, other nuts, fruit, mushrooms, algae, and mosses are also heavily utilized when available (Moore 1978). Seasonal usage of weeds, grasses, and agricultural crops as primary food items results in deer being more visible in spring and summer, when they often have a severe impact upon early farm crops.

The major limiting factor of deer populations is man. Man has taken over the role of regulating deer numbers from the cougar and other large predators. Natural factors affecting deer herds include extensive agricultural land use, overpopulation and resultant die-off due to malnutrition and parasites. Leopold et al. (1947) credited the screw-worm as a serious limiting factor.

b. Harvest and Population. Perhaps the most reliable, consistent long-term analysis of deer population density in either State is available from the Cape Romain National Wildlife Refuge, Awendaw, South Carolina. A 36-year summary of population estimates and hunter-kill data is available for Bull Island, where hunting has been well controlled, discrete population estimates made, and two natural deer die-offs documented (Table 8-34). It is unfortunate that similar long-term data are not available on an area-by-area basis. Only sporadic estimates on a one time basis have been reported. Table 8-35 presents 1975-76 statewide harvest data, number of hunters, and man-days hunted for white-tailed deer in South Carolina. An estimated total of 74,977 deer were harvested in South Carolina by 103,639 hunters during this period. Table 8-36 presents hunter participation and harvest for the major game species in Georgia from 1962 to 1978. For the 1975-76 hunting season, 218,231 hunters killed 56,183 deer in Georgia.

2. Mourning Dove

The mourning dove is widely distributed within the United States, occurring within all contiguous 48 states. Southern populations of mourning doves do not express much seasonal movement and, unlike other game birds, the dove population has increased along with the progress of civilization (Mahan 1978a). The dove ranks second in hunter participation in South Carolina and Georgia (Tables 8-32 and 8-33).

a. Limiting Factors. Mourning doves can be seen along roadsides, in open woodlands, in suburbs, and on farmland. Doves prefer to feed on ground relatively free of dense vegetation. Nesting sites are generally along field or pasture edges in pines, southern red cedar, dogwoods, oaks, or low-growing shrubs. Heaviest nest destruction is brought about by storms, which often wipe out large numbers of the flimsy stick nests (Jenkins 1953).

Mourning doves are vegetarian in food preference, dining on grains and other seeds. A majority of the dove's diet is composed of native and cultivated grasses including barley, oats, wheat, corn, millets, milo, Johnson grass, bullgrass, foxtail grass, and crabgrass. Legumes such as cowpeas, soybeans, and peanuts may also be taken, but are not as preferred as grass seed.

Like most seed-eating birds, doves require grit to help grind their food. Grit is normally composed of small bits of

Table 8-34. Deer populations harvested by bow on Bull Island, South Carolina (U.S. Department of Interior, Fish and Wildlife Service 1977b).

YEAR	ESTIMATED POPULATION	HARVEST
1941	175	No hunt
1945	200	"
1950[a]	15	"
1955	185	2
1956	NA	18
1957	NA	3
1958	NA	5
1959	NA	4
1960	210	12
1961	210	16
1962	210	14
1963	230	32
1964	250	29
1965	250	39
1966	200	28
1967	280	39[b]
1968	180	9
1969	260	21
1970	300	27
1971[a]	350	37
1972	250	49
1973	260	14
1974	200	29
1975	250	30
1976	300	89

a. Denotes years of known natural die-off.
b. Shotgun hunt in addition to bow hunt.

sand or gravel, but small snail shells and hard insect parts may also be used. In addition to food and grit, doves require a daily supply of fresh water to prevent dehydration and to soften and aid in digestion of food (Mahan 1978a).

In South Carolina, from three to five broods may be produced each year and nesting doves have been observed even during winter months (Mahan 1978a). In Georgia, Hopkins and Odum's (1953) study on dove breeding reported a low production rate which was due to an unusually low nesting success. They theorized that their study did not represent the "normal" or "healthy" population condition. However, Lowe (1956) verified their findings of low production due to low nesting success.

The normally high production rate is needed to balance the high mortality rate imposed by nature. The life span of doves is generally between 1 and 3 years; however, most doves seldom live more than 1 year. Predation accounts for only a small percentage of doves lost. Disease and starvation may take a high toll in certain areas and under certain conditions.

Severe winter weather may at times induce heavy mortality in dove populations. Deep snow, ice storms, and unusually cold weather are especially deadly when they occur in the southern portion of the range, as these populations are not adapted to such weather extremes (Mahan 1978a).

b. Harvest and Population. Table 8-37 presents 1975-76 harvest data for mourning doves in South Carolina, plus number of hunters and man-days hunted. A total of 103,259 hunters were estimated to have participated in the shooting of mourning doves in South Carolina during the year. Of this total, 25,055 hunted on management areas that included public dove fields. Doves ranked first in harvest in South Carolina during this period (Webb 1976). In Georgia, doves were the second most sought after species (Table 8-33), but consistently ranked first in total harvest (Table 8-36).

3. Bobwhite Quail

The distribution of bobwhite quail in the United States is described by Rosene (1969) as: the Southeastern United States, where the overall population does

Table 8-35. Estimated number of licensed hunters that hunted deer (buck and doe), number of deer harvested, and number of man-days spent hunting deer in South Carolina during 1975-76, as stratified by game management and nongame management areas for various types of licenses, with average hunting days per deer killed in 1975-76 as compared to similar total kill data for 1966-67 and 1963-64 (± data relate to 95% confidence intervals) (Webb 1976).

Type of Area and License	Hunters	Harvest	Man-Days Hunted	Avg. Man-Days/Deer Kill[a] 1975-76	1966-67	1963-64
MANAGEMENT AREAS						
State	22,398(±11,630)	7,782(± 5,900)	270,104(±66,540)	34.71		
County	1,898(±12,300)	1,708(± 2,561)	10,060(± 8,605)	5.89		
Combination Hunt. & Fish.	25,245(±11,592)	12,718(± 4,299)	280,164(±47,579)	22.03		
Annu. Nonresident	4,176(±12,233)	1,519(± 1,011)	41,190(±15,420)	27.12		
Three day Nonresident	2,088(±12,295)	569(± 1,113)	7,403(± 1,771)	13.01		
Total	55,805(±10,592)	24,296(± 7,851)	608,921(±84,312)	25.06		
NONMANAGEMENT AREA						
State	19,741(±11,763)	15,944(± 6,957)	190,384(±38,242)	11.94		
County	3,986(±12,239)	2,278(± 1,149)	28,662(±11,714)	12.58		
Combination Hunt. & Fish.	37,204(±11,211)	31,130(± 7,738)	394,813(±66,854)	12.68		
Annu. Nonresident	2,657(±12,278)	949(± 1,168)	30,560(±17,146)	32.20		
Three day Nonresident	2,278(±12,289)	380(± 742)	6,833(± 1,733)	17.98		
Total	65,866(±10,242)	50,681(±10,585)	651,252(±80,247)	12.85		
GRAND TOTAL[b]	103,639(± 8,804)	74,977(±13,221)	1,260,173(±119,600)	16.81	12.20	9.60

a. Data on man-days per kill only obtained on total deer harvested in 1966-67 and 1963-64 surveys.

b. Number of hunters in grand total includes only once the 18,032 hunters that hunted buck and doe deer on both management and nonmanagement areas, while the total harvest and man-days hunted data are actual totals from hunting on both types of areas.

Table 8-36. Harvest survey and hunter participation results for the major game species in Georgia from 1962 - 1978 (Georgia Department of Natural Resources, unpubl. data).

Species	1962-63[a]	1963-64[a]	1964-65[a]	1965-66[a]	1966-67[a]	1967-68[a]	1968-69[a]	1969-70[a]
QUAIL								
Hunters	135,000	127,000	135,000	124,000	139,000	122,000	135,000	114,315
Effort[b]	1,234,000	1,158,000	1,174,000	901,000	1,177,000	980,000	1,047,000	881,202
Harvest	4,058,000	3,365,000	3,387,000	2,821,000	3,381,000	2,499,000	3,107,000	2,474,398
RABBIT								
Hunters	116,000	120,000	115,000	118,000	121,000	113,000	112,000	98,381
Effort[b]	896,000	852,000	785,000	790,000	871,000	670,000	681,000	537,089
Harvest	1,457,000	1,364,000	1,169,000	1,176,000	1,406,000	1,047,000	1,017,000	760,115
DUCK								
Hunters	- -	- -	- -	- -	30,000	25,000	27,000	24,308
Effort[b]	- -	- -	- -	- -	128,000	116,000	138,000	108,833
Harvest	- -	- -	- -	- -	170,000	130,000	146,000	118,403
1st DOVE								
Hunters	- -	82,000	95,000	93,000	101,000	95,000	125,000	108,961
Effort[b]	- -	360,000	464,000	353,000	458,000	429,000	534,000	421,930
Harvest	- -	1,500,000	2,294,000	2,048,000	2,261,000	2,148,000	2,737,000	2,234,219
2nd DOVE								
Hunters	- -	62,000	67,000	69,000	74,000	54,000	69,000	55,065
Effort[b]	- -	275,000	321,000	305,000	326,000	275,000	306,000	222,078
Harvest	- -	1,229,000	1,527,000	1,392,000	1,561,000	1,229,000	1,462,000	1,061,703
3rd DOVE								
Hunters	- -	- -	- -	- -	- -	- -	- -	- -
Effort[b]	- -	- -	- -	- -	- -	- -	- -	- -
Harvest	- -	- -	- -	- -	- -	- -	- -	- -

Table 8-36. Continued.

Species	1962-63[a]	1963-64[a]	1964-65[a]	1965-66[a]	1966-67[a]	1967-68[a]	1968-69[a]	1969-70[a]
SQUIRREL								
Hunters	131,000	136,000	144,000	143,000	146,000	142,000	144,000	122,993
Effort[b]	875,000	924,000	937,000	991,000	1,032,000	913,000	911,000	705,759
Harvest	1,593,000	1,733,000	1,664,000	1,726,000	1,771,000	1,504,000	1,694,000	1,220,374
DEER								
Hunters	86,000	104,000	113,000	119,000	130,000	140,000	154,000	153,938
Effort[b]	442,000	620,000	637,000	748,000	842,000	885,000	1,020,000	1,033,108
Harvest	13,000	21,000	21,000	25,000	19,000	21,000	24,000	28,190
TURKEY								
Hunters	- -	- -	- -	- -	- -	- -	- -	- -
Effort[b]	- -	- -	- -	- -	- -	- -	- -	- -
Harvest	- -	- -	- -	- -	- -	- -	- -	- -
WOODCOCK								
Hunters	- -	- -	- -	- -	- -	- -	- -	- -
Effort[b]	- -	- -	- -	- -	- -	- -	- -	- -
Harvest	- -	- -	- -	- -	- -	- -	- -	- -
MARSH HEN								
Hunters	- -	- -	- -	- -	- -	- -	- -	- -
Effort[b]	- -	- -	- -	- -	- -	- -	- -	- -
Harvest	- -	- -	- -	- -	- -	- -	- -	- -

Table 8-36. Continued.

Species	1970-71[a]	1971-72[a]	1972-73[a]	1973-74[a]	1974-75[a]	1975-76[a]	1976-77[a]	1977-78[a]
QUAIL								
Hunters	115,180	107,224	111,986	113,689	113,521	101,103	87,172	84,756
Effort[b]	886,777	868,519	886,261	890,334	931,459	733,898	618,681	610,245
Harvest	2,639,806	2,566,789	2,495,057	2,614,605	2,311,060	1,884,103	1,511,497	1,473,810
RABBIT								
Hunters	92,615	80,962	83,608	88,931	86,803	82,239	75,771	75,004
Effort[b]	557,974	517,688	485,948	553,431	481,529	457,084	443,529	416,938
Harvest	798,357	706,611	668,032	691,024	613,763	645,540	495,321	521,729
DUCK								
Hunters	28,433	21,981	24,259	24,434	27,739	23,936	22,855	22,903
Effort[b]	140,627	97,699	104,465	110,915	121,236	104,515	101,705	93,587
Harvest	160,148	95,146	112,728	123,874	152,231	145,397	123,736	100,188
1st DOVE								
Hunters	106,785	101,166	113,540	119,524	80,842	124,245	100,596	91,664
Effort[b]	434,468	355,923	377,503	451,569	322,000	434,318	375,939	373,998
Harvest	2,326,671	1,860,881	1,990,818	2,123,303	1,558,940	2,131,600	1,910,352	1,814,500
2nd DOVE								
Hunters	60,608	52,157	184,801	73,959	61,339	62,685	54,103	50,020
Effort[b]	238,093	178,675	277,331	270,941	301,603	211,063	205,488	212,441
Harvest	1,226,642	894,966	1,325,956	1,346,292	1,577,360	1,067,200	1,040,835	1,046,460
3rd DOVE								
Hunters	- -	29,571	- -	- -	- -	- -	- -	- -
Effort[b]	- -	100,995	- -	- -	- -	- -	- -	- -
Harvest	- -	554,871	- -	- -	- -	- -	- -	- -

Table 8-36. Concluded.

Species	1970-71[a]	1971-72[a]	1972-73[a]	1973-74[a]	1974-75[a]	1975-76[a]	1976-77[a]	1977-78[a]
SQUIRREL								
Hunters	130,610	122,912	126,098	133,540	131,375	125,198	114,604	122,709
Effort[b]	812,969	820,603	812,098	879,807	732,160	758,835	706,862	815,673
Harvest	1,491,645	1,441,745	1,341,557	1,463,121	1,290,200	1,301,520	1,070,605	1,368,630
DEER								
Hunters	163,419	149,751	170,310	186,961	212,536	218,231	213,853	232,848
Effort[b]	1,184,758	1,098,421	1,437,903	1,587,972	1,932,480	1,988,080	1,963,452	2,222,100
Harvest	29,004	28,788	37,714	38,489	62,875	56,183	63,403	73,656
TURKEY								
Hunters	- -	- -	4,697	8,299	9,054	8,803	6,256	8,329
Effort[b]	- -	- -	24,949	33,152	31,413	31,771	22,593	27,228
Harvest	- -	- -	1,402	2,050	2,982	2,930	1,729	1,843
WOODCOCK								
Hunters	- -	- -	5,633	6,845	7,245	4,808	5,406	6,108
Effort[b]	- -	- -	18,092	37,303	26,807	18,615	23,168	28,537
Harvest	- -	- -	21,027	29,477	43,635	18,381	29,555	21,350
MARSH HEN								
Hunters	- -	- -	- -	4,241	- -	- -	- -	- -
Effort[b]	- -	- -	- -	11,024	- -	- -	- -	- -
Harvest	- -	- -	- -	72,907	- -	- -	- -	- -

[a] All figures rounded to nearest thousand.
[b] Man-days.

Table 8-37. Estimated number of licensed hunters that hunted doves, number of doves harvested, and number of man-days spent hunting doves in South Carolina during 1975-76, as stratified by game management and nongame management areas for various types of licenses and doves harvested per day of hunting in 1975-76, as compared to 1966-67 and 1963-64 surveys. (± data relate to 95% confidence interval) (Webb 1976).

Type of License	Hunters	Harvest	Days	Dove Kill Per Man-Day of Hunting[a] 1975-76	1966-67	1963-64
MANAGEMENT AREA						
State	10,250(±12,052)	268,208(±107,502)	97,944(±68,938)	2.74		
County	2,657(±12,278)	21,639(± 14,049)	13,666(± 7,462)	1.58		
Combination Hunt. & Fish.	11,199(±12,023)	342,044(±113,408)	53,528(±12,603)	6.39		
Annu. Nonresident	380(±12,345)	11,389(± 18,570)	949(± 1,114)	12.00		
Three day Nonresident	569(±12,340)	1,329(± 1,616)	1,519(± 980)	.87		
Total	25,055(±11,598)	644,609(±159,853)	167,606(±70,840)	3.85		
NONMANAGEMENT						
State	29,801(±11,448)	910,538(±171,084)	194,939(±43,894)	4.67		
County	5,315(±12,199)	67,955(± 30,198)	25,814(±11,631)	2.63		
Combination Hunt. & Fish.	45,935(±10,925)	1,773,433(±250,900)	287,189(±36,886)	6.18		
Annu. Nonresident	3,417(±12,256)	114,078(± 52,501)	10,630(± 3,697)	10.73		
Three day Nonresident	569(±12,340)	3,227(± 3,870)	1,708(± 2,224)	1.89		
Total	85,037(± 9,539)	2,869,231(±313,869)	520,280(±58,829)	5.51		
GRAND TOTAL[b]	103,259(± 8,819)	3,513,840(±360,727)	687,886(±96,456)	5.11	3.88	3.79

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a. Data on dove kill per man-day hunting obtained only on total dove harvested per trip in 1966-67 and 1963-64 surveys.

b. Number of hunters in grand total includes only once the 6,833 hunters that hunted doves on both management areas and nonmanagement areas while the total harvest and man-days hunted data are actual totals from hunting on both types of areas.

not fluctuate annually; and "the fringe area to the north and west where year-to-year populations are likely to vary."

A historical review reveals that quail populations have increased and declined as man and the progress of civilization have continued to alter the environment. Early land use practices associated with pioneer settlements were typified by a patchy farming pattern which provided ideal quail habitat, and quail increased until around 1900 (Mahan 1978b).

From the early 1900's to the mid-1940's, quail population densities remained high and quite stable. However, since the mid-1940's, quail numbers have declined over much of the South. This downward trend is largely associated with deteriorating habitat conditions resulting from: 1) a change to cleaner and more mechanized farming methods, 2) the joining of small patchwork fields to make large unbroken fields suitable for intensive cultivation, 3) development of pastures for cattle, dairy, or hay production, 4) intensified timber production, and 5) restricted use of fire in pine forests, which has created woodlands too dense for permanent habitation by quail. Few wild species, however, are more capable than quail of adapting to man's manipulation of the environment (Mahan 1978b).

a. Limiting Factors. Adequate cover is seldom limiting over the well-watered Southeast, but preferred quail foods may be scarce. Ideal habitat combines heavy cover with cultivated land, some brushland, and some grassland (Jenkins 1953). Controlled burning is used in both States as a quail management tool to enhance preferred habitat. In general, quail like a diversity of cover types including forests, brush, grass, and cultivated lands. When one or more of these conditions exist, quail population levels usually depend largely on the amount and distribution of these four habitat types. Bobwhites prefer areas where all of these habitat types may be found within their normal 40 acre (16 ha) range (Mahan 1978b).

Quail primarily feed in fields and open forests. Their diet is mainly vegetable and is composed largely of seeds, small fruits, and green forage. Animal matter may be consumed year around, but makes up a higher percentage of the diet during warmer months. Insects are an especially important source of protein in the diet of young quail. Seeds of legumes are probably the most important native quail foods, with grasses, beggar lice, and sedges being of secondary importance. Soft and hard mast plants and cultivated grains are also taken. In Georgia, legumes make up the bulk of preferred food plants (Jenkins 1953).

Some of the most important food items utilized in South Carolina include: native beggar lice, partridge peas, milk peas, butterfly peas, native and cultivated lespedezas, sesbania, fringe-leaved paspalum, panic grass, ragweed, chocolate weed, blackberry, mulberry, pine, oak, sweet gum, and cultivated crops such as cowpeas, soybeans, milo, wheat, and corn. Although quail are commonly seen in the vicinity of open water and are occasionally observed to drink surface water, this is not essential as they normally receive their water requirements from dew, insects, and succulent plants.

Predation is not considered an important limiting factor in quail populations, nor is there evidence indicating that parasites and diseases are important limiting factors. On the whole, low nesting success due to fires, inclement weather, and agricultural activity, along with scarcity of winter foods, results in low population levels. Additionally, over-hunting is not considered a serious limiting factor since many quail coveys persist through the winter season in areas where hunters do not hunt. These quail then move to unoccupied ranges to produce young during the following year (Webb 1966). Rogers' (1977) survey of quail populations in southwestern South Carolina concluded that the major factors in population decline are habitat deficiency and de-emphasis of management techniques.

b. Harvest and Population. Table 8-38 presents 1975-76 harvest data for bobwhite quail in South Carolina, including number of hunters and man-days hunted. The number of hunters estimated to have hunted quail in South Carolina during 1975-76 totalled 77,634. The harvest of quail in 1975-76 totalled 1,887,508. Additionally, South Carolina data accumulated by Rosene (1956) are not presented, but his 1957 research on using summer cock counts as an index to wintering populations is summarized in Table 8-39. Six areas in South Carolina, utilizing a total of 6,702 acres (2,712 ha) near Ridgeland, Georgetown, and Pineville, were studied for population levels. Georgia data are presented in Table 8-36.

4. Squirrels

Both the gray squirrel and fox squirrel are found in South Carolina and Georgia. However, in both States the gray squirrel is by far the most abundant (Jenkins 1953, Bevill 1978a). Since the only significant difference, in terms of management, is habitat preference, no differentiation between species will be attempted other than habitat discussions.

a. Limiting Factors. Squirrels are primarily vegetarians; therefore, their production and survival rates fluctuate with the changing availability of hard

Table 8-38. Estimated number of licensed hunters that hunted quail, number of quail harvested, and number of days spent hunting quail in South Carolina during 1975-76, as stratified by game management and nongame management areas for various types of licenses and average number of quail harvested per man-day of hunting in 1975-76, as compared to 1966-67 and 1963-64 surveys. (± data relate to 95% confidence intervals) (Webb 1976).

				Quail Kill Per Man-Day of Hunting[a]		
Type of License	Hunters	Harvest	Days	1975-76	1966-67	1963-64
MANAGEMENT AREA						
State	5,125(±12,205)	64,727(± 37,298)	32,838(±14,341)	1.97		
City	1,519(±12,312)	21,069(± 20,491)	10,060(± 7,206)	2.09		
Combination Hunt. & Fish.	8,542(±12,103)	263,081(±158,245)	68,333(±32,851)	3.85		
Annu. Nonresident	569(±12,340)	11,769(± 22,987)	5,884(± 5,190)	2.00		
Three day Nonresident	1,898(±12,300)	10,630(± 8,818)	5,315(± 3,118)	2.00		
Total	17,653(±11,827)	371,276(±151,265)	122,430(±37,104)	3.03		
NONMANAGEMENT AREA						
State	21,259(±11,716)	368,620(±107,234)	137,615(±32,773)	2.68		
County	4,176(±12,233)	48,972(± 37,949)	31,319(±21,522)	1.56		
Combination Hunt. & Fish.	34,546(±11,297)	965,960(±258,107)	282,064(±52,024)	3.42		
Annu. Nonresident	3,986(±12,239)	122,240(± 58,406)	26,574(± 9,177)	4.60		
Three day Nonresident	1,139(±12,323)	10,440(± 7,592)	2,848(± 1,113)	3.67		
Total	65,106(±10,269)	1,516,232(±290,495)	480,420(±65,289)	3.16		
GRAND TOTAL[b]	77,634(± 9,817)	1,887,508(±373,355)	602,850(±76,634)	3.13	2.25	2.27

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a. Data on quail kill per man-day of hunting obtained only on total quail harvest per trip in 1966-67 and 1963-64 surveys.

b. Number of hunters in grand total includes only once the 5,125 hunters that hunted quail on both management and nonmanagement areas while the total harvest and man-days hunted data are actual totals from hunting on both types of areas.

Table 8-39. **Numbers of bobwhite quail whistling cocks heard per 1,000 acres[a] in summer, and numbers of coveys found in subsequent hunting seasons in South Carolina (Rosene 1957).**

		1950		1951		1952		1953		Average		Coveys per Whistling Cock
		Cocks	Coveys	Cocks	Coveys	Cocks	Coveys	Cocks	Coveys	Cocks	Coveys	
South Carolina												
Study area	1	--	--	25.1	24.0	26.3	18.3	18.3	20.6	23.2	21.0	0.90
	2	--	--	18.2	12.2	10.1	14.2	13.2	8.1	13.8	11.5	0.83
	3	--	--	18.1	10.7	13.2	8.3	13.2	9.1	14.8	9.3	0.63
	4	--	--	32.1	20.8	30.2	34.0	32.1	28.3	31.5	27.7	0.88
	5	20.7	29.6	22.2	34.8	25.2	20.0	15.5	22.2	20.9	26.7	1.28
	6	16.6	9.2	16.6	15.2	14.9	13.5	18.3	18.9	16.6	14.2	0.85
Average		18.7	19.4	22.1	19.6	20.0	18.1	18.4	17.9	20.0	18.6	0.93

a. 1 acre = 0.4047 ha.

mast materials, particularly acorns. When hard mast is not available, squirrels feed on other fruits and berries, floral parts, buds, bark, roots, mushrooms, and some animal matter. About one and a half pounds of mast per week are required to support one squirrel from September through March (Jenkins 1953, Golley 1966, Snyder 1972). The order of preference for hard-mast varieties is hickory nuts, beechnuts, white oak acorns, and black oak acorns. This preference order varies from place to place because of differing habitat availability.

When heavy-seeded mast crops fail, competition for food becomes intense. Younger members of the population are forced out of the home range by the more dominant adults. Mortality of sub-adults increases and reproduction may cease. Mast failure during a population peak is the prime cause of these emigrations (Bevill 1978a).

Both species of squirrels prefer mature forests of mixed mast-producing stands. While their distributions within the Sea Island Coastal Region overlap completely, gray squirrels tend to prefer dense bottomlands and stands of hardwoods while fox squirrels are generally more common in more open pine uplands (Jenkins 1953, Golley 1962, 1966). Snyder's (1972) study of population densities of gray squirrels in the South Carolina Piedmont showed that the largest populations occurred in hardwood habitats, the second largest populations occurred in mixed pine-hardwood habitats, and the smallest populations occurred in pine habitats. This would also probably be true in the coastal plain.

Like most wildlife species, squirrels have a high mortality rate during their first year, but the potential life span is about 6 years in the wild. In captivity, squirrels can live for 15 years. With continually changing habitat conditions and other factors that help regulate reproductive rates, squirrel populations are very cyclic. When a population eruption results in mass emigrations, nearly all squirrels leave the area. Populations building back from such a mass movement will usually take about 5 years to peak again (Bevill 1978a).

Natural predators of the gray squirrel include rat snakes; red-tailed, red-shouldered, marsh, and Cooper's hawks; great horned and barred owls; red and gray foxes; bobcats; weasels; raccoons; house cats; and dogs. However, considering that population build-up to the point of migration is fairly common, these natural predators are not really limiting to overall population growth.

When squirrel populations become overcrowded, parasites and diseases can become serious problems. The warble fly ranks as the squirrel's most serious parasite pest. This fly lays its eggs on tree bark, and when the eggs hatch, larvae transfer to the first passing squirrel. The larva burrows under the skin and transforms into a large grub, which keeps a hole open in the skin in order to breathe. Death can occur from secondary infections. Scabies, or mange, is caused by the scabies mite and can also be fatal to squirrels. Ticks, fleas, and lice are minor nuisances which also serve as vectors for other parasite and disease organisms.

b. Harvest and Population. Table 8-40 presents 1975-76 harvest data for both species of squirrels by number of hunters and man-days hunted. Table 8-41 presents 1975-76 harvest data for the gray squirrel only. During 1975-76, the number of squirrel hunters (including out-of-state residents) was estimated to be 77,444 and ranked below deer, mourning dove, and quail in hunter participation. The only other recent South Carolina study that gives an indication of population levels is Snyder's (1972) study. Georgia data are summarized in Table 8-36.

5. Rabbits

Three species of rabbits are found in South Carolina and Georgia. The eastern cottontail is the most common and is statewide in distribution. The swamp rabbit or "cane-cutter" occurs in the region, primarily along or adjacent to the Savannah River and is the largest of the three species. The marsh rabbit inhabits the coastal plain portion of the two States and is the smallest of the three species (Jenkins 1953, Mahan 1978c). The primary difference in the three species from a management standpoint is their habitat preferences. Hence, they will be treated collectively in the following paragraphs. Although these rabbits are three distinct species, they are all commonly referred to as cottontails by the average hunter and other laymen.

Rabbits were not abundant in the United States when the white man arrived, but with the introduction of early agriculture, their numbers increased. In recent years, changing land use practices, particularly the conversion of patchy farming to forest production and intensive farming, have resulted in a rabbit population decline. Rabbits, like quail, are sedentary and rarely move more than a mile (1.6 km) from their birthplace, often spending their lives in an area of less than 10 acres (4 ha) in extent (Trippensee 1948).

Table 8 - 40. **Estimated number of licensed hunters that hunted squirrels (gray and fox), number of squirrels harvested, and number of man-days spent hunting squirrels in South Carolina during 1975-76, as stratified by game management areas and nonmanagement areas for various types of licenses, with average number of squirrels killed per man-day of hunting in 1975-76 as compared to similar total kill data for 1966-67 and 1963-64 surveys. (± data relate to 95% confidence intervals) (Webb 1976).**

Type of License	Hunters	Harvest	Days	Avg. No. Squirrel Killed Per man-day hunted[a]		
				1975-76	1966-67	1963-64
MANAGEMENT AREA						
State	12,527(±11,983)	116,166(±35,363)	74,407(±17,100)	1.56		
County	3,227(±12,261)	31,699(±16,506)	22,398(± 7,976)	1.42		
Combination Hunt. & Fish.	9,491(±12,074)	102,500(±50,255)	78,583(±40,093)	1.30		
Annu. Nonresident	380(±12,345)	3,037(± 2,971)	759(± 742)	4.00		
Three day Nonresident	190(±12,351)	2,657 NP[c]	1,898 NP[c]	1.40		
Total	25,815(±11,574)	256,059(±63,319)	178,045(±43,997)	1.44		
NONMANAGEMENT AREA						
State	21,449(±11,710)	213,921(±38,949)	184,879(±58,348)	1.16		
County	5,694(±12,188)	45,555(±19,086)	97,376(±26,881)	.66		
Combination Hunt. & Fish.	29,990(±11,442)	297,249(±47,000)	215,059(±43,931)	1.38		
Annu. Nonresident	1,139(±12,323)	6,264(± 4,054)	2,847(± 953)	2.20		
Three day Nonresident	380(±12,345)	3,417(± 4,457)	1,708(± 1,857)	2.00		
Total	58,652(±10,495)	566,406(±64,160)	501,869(±82,176)	1.13		
GRAND TOTAL[b]	77,444(± 9,824)	822,465(±94,475)	679,914(±94,368)	1.21	1.50	1.40

a. Data on kill per man-day obtained only on total squirrels harvested per trip in 1966-67 and 1963-64 surveys.

b, Number of hunters in grand total includes only once the 7,023 squirrel hunters that hunted gray and fox squirrels on both management and nonmanagement areas while the total harvest and man-days hunted data are actual totals from hunting on both types of areas.

c. NP - Non-projectable.

Table 8 - 41. Estimated number of licensed hunters that hunted gray squirrels, number of gray squirrels harvested, and number of days spent hunting gray squirrels in South Carolina during 1975-76, as stratified by game management and nongame management areas for various types of license, with associated average number of gray squirrels harvested per man-day of hunting in 1975-76. (± data relate to 95% confidence interval) (Webb 1976).

Type of License	Hunters	Harvest	Days	Squirrel Kill Per Man-Day
MANAGEMENT AREA				
State	11,958(±12,000)	111,990(±35,087)	66,245(±15,760)	1.69
County	3,037(±12,267)	28,093(±16,044)	19,171(± 7,504)	1.47
Combination Hunt. & Fish.	9,111(±12,086)	97,185(±46,582)	70,801(±37,759)	1.37
Annu. Nonresident	380(±12,345)	3,037(± 2,971)	759(± 742)	4.00
Three day Nonresident	190(±12,351)	0(± 0)	190 NP[b]	.00
Total	24,676(±11,609)	240,305(±60,262)	157,166(±41,656)	1.53
NONMANAGEMENT AREA				
State	20,880(±11,727)	204,050(±37,590)	140,652(±42,588)	1.45
County	5,694(±12,188)	44,227(±19,291)	67,954(±45,239)	.65
Combination Hunt. & Fish.	28,661(±11,484)	282,062(±46,019)	205,189(±43,927)	1.37
Annu. Nonresident	949(±12,328)	5,884(± 3,819)	2,278(± 945)	2.58
Three day Nonresident	380(±12,345)	380(± 742)	949(± 371)	.40
Total	56,564(±10,566)	536,603(±62,707)	417,022(±76,352)	1.29
GRAND TOTAL[a]	74,407(± 9,935)	776,908(±91,349)	574,188(±88,287)	1.35

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a. Number of hunters in grand total includes only once the 6,833 hunters that hunted gray squirrel on both management and nonmanagement areas while the total harvest and man-days hunted data are actual totals from hunting on both types of areas.

b. NP - Non-projectable.

a. Limiting Factors. Rabbits eat an extremely wide variety of plant foods. Some of the more general items include grasses, sedges, sprouts, leaves, fruits, buds, and bark. During the summer, rabbits dine primarily on grasses, legumes, succulent annuals, weeds, and an occasional garden vegetable. The winter diet includes small grain, as well as twigs, bark, and buds of shrubs and trees. In agricultural areas, grains such as corn and soybeans provide a source of high energy food when suitable adjacent escape cover is available (Mahan 1978c).

Cover requirements for rabbits closely resemble those of quail in that they require a diversity of habitats, preferably an interspersion of woodlands, brush, grass, and cultivated lands. The availability of briar patches, multiflora rose hedges, stone piles, and brush piles, interspersed with winter cover crops, can increase rabbit numbers several fold over the number found on overgrazed pastures and open pinelands (Jenkins 1953).

Rabbits are extremely prolific. Conaway et al. (1963) reported the total annual production of young by an adult female to be approximately 35 in the Southeastern United States. This high reproductive capacity is essential because they are the most heavily preyed upon game species, and because they are also susceptible to a variety of diseases and parasites (Mahan 1978c).

During certain seasons of the year, both terrestrial and avian predators may subsist mainly on a diet of rabbits. Foxes are probably the most important predators on rabbits, which at times compose as much as 50% of their diet. The bobcat also preys heavily on rabbits and nearly 75% of its diet may be rabbits. The larger hawks and owls also consume rabbits readily, and up to 40% of a great horned owl's diet may be composed of rabbits. Rabbits are hunted effectively by practically every wild predator which can catch and subdue them, including coyotes, crows, dogs, feral house cats, foxes, hawks, minks, owls, snakes, skunks, and weasels (Mahan 1978c). It is this heavy predation that keeps rabbit populations strong, healthy, and controlled.

Diseases and parasites are common among rabbits, and the most obvious rabbit afflictions are larvae of the warbler fly, commonly referred to as "wolves," "warblers," or "bots." These terms describe the grub-like appearance of the parasite when it is found under the skin of infected rabbits. These parasites are more abundant during warmer weather and are generally gone from infected rabbits by late fall or early winter.

The most important and deadliest disease affecting rabbits is tularemia or "rabbit fever." The causative organism is a bacterium, Pasteurella tularensis, transmitted from rabbit to rabbit by ticks. Man is also susceptible to this disease, but tularemia responds to antibiotics (Jenkins 1953, Mahan 1978c).

b. Harvest and Population. Table 8-42 presents 1975-76 harvest data for rabbits, including the number of hunters and man-days hunted in South Carolina. During the 1975-76 season, the number of rabbit hunters was estimated to be 63,018, ranking fifth in hunter participation (Table 8-32) in South Carolina. Rabbit hunting ranked fifth in hunter participation in Georgia during the 1977-78 season (Table 8-36).

6. Raccoon

The raccoon is common to all of North America except portions of the Rocky Mountains and the more arid sections of the Great Basin. The species has been of great economic value and public health significance and is an important source of recreation. During the 1920's, raccoon pelts brought high prices. With subsequent decline in demand for raccoon coats, there was a corresponding decline in value of pelts and numbers harvested. Raccoon depredations on crops such as corn, melons, and fruits are a problem in agricultural areas.

a. Limiting Factors. Raccoons frequent a variety of habitat types; however, they are closely tied to bottomland hardwood areas from which excursions are made into various upland and marsh types. In southwestern Georgia and northwestern Florida, raccoon catch per trap night was greatest in bottomland hardwoods; intermediate in cultivated lands, abandoned fields, and upland hardwoods; and lowest in pine forest (McKeever 1975). Johnson (1970), using radio telemetry, always found raccoons in close association with bottomland hardwoods. The presence of a mature hardwood forest with good denning trees seems to be an important habitat characteristic. Variety in habitat is necessary to provide diverse feeding opportunities during all seasons. Consequently, different stages of forest succession in upland areas tend to complement mature bottomland requirements.

During periods of food abundance, raccoons are quite selective; during periods of food scarcity, however, they utilize whatever is available. Persimmons, muscadine and summer grapes, wild plums, acorns, corn, and miscellaneous plant parts make up the major portion of the diet from summer to late fall. Animal matter becomes of greater importance during other times of the year. Insects are of importance in the spring, after depletion of mast foods during winter and prior to maturity of various fruits in the

Table 8-42. Estimated number of licensed hunters that hunted rabbits, number of rabbits harvested, and number of days spent hunting rabbits in South Carolina during 1975-76, as stratified by game management and nongame management areas for various types of licenses, and average number of rabbits harvested per man-days of hunting in 1975-76 as compared to 1966-67 and 1963-64 surveys. (± data relate to 95% confidence intervals) (Webb 1976).

Type of License	Hunters	Harvest	Days	Avg. No. Rabbit Killed Per Man-days hunted[a]		
				1975-76	1966-67	1973-64
MANAGEMENT AREA						
State	6,833(±12,154)	59,791(±28,076)	63,967(±27,151)	.93		
County	2,847(±12,272)	20,500(± 9,488)	22,968(±12,696)	.89		
Combination Hunt. & Fish.	8,162(±12,114)	88,833(±60,657)	74,407(±41,183)	1.19		
Total	17,842(±11,821)	169,124(±67,213)	161,342(±50,534)	1.05		
NONMANAGEMENT AREA						
State	18,412(±11,803)	92,060(±23,565)	103,828(±39,183)	.89		
County	4,556(±12,222)	24,106(±19,002)	46,504(±43,608)	.52		
Combination Hunt. & Fish.	25,054(±11,598)	224,740(±56,726)	193,800(±49,677)	1.16		
Annu. Nonresident	190(±12,351)	2,658(± 0)	1,139(± 0)	2.33		
Three day Nonresident	190(±12,351)	190 NP[c]	190 NP	1.00		
Total	48,402(±10,843)	343,754(±65,198)	345,461(±76,726)	1.00		
GRAND TOTAL[b]	63,018(±10,343)	512,878(±95,980)	506,803(±95,699)	1.01	1.25	1.30

a. Data on kill per man-day obtained only on total rabbit harvest per trip in 1966-67 and 1963-64 surveys.

b. Number of hunters in grand total includes only once the 3,226 hunters that hunted rabbits on both management and nonmanagement areas while the total harvest and man-days hunted data are actual totals from hunting on both types of areas.

c. NP - Non-projectable.

summer. Undoubtedly, eggs and young of a variety of animal species are seasonally important (Johnson 1970). Coastal and barrier island raccoons, foraging along the land-water interface, utilize a variety of marine organisms for food during much of the year. The raccoon's importance as a predator on nests of the loggerhead turtle is discussed in Volume III, Chapter Two.

Predation on raccoons in coastal Georgia and South Carolina is probably negligible. The main predators capable of taking raccoons in this area are man, alligators, bobcats, foxes, hawks, and owls. Studies, however, have shown that raccoons occur infrequently in the diets of these species (Giles and Childs 1949, Kight 1962).

Apparently the greatest mortality of raccoons, other than hunting by man, occurs as a result of disease. Specific diseases of importance as major mortality factors include rabies, canine distemper, and verminous pneumonia. Canine distemper has been implicated as a major mortality factor over large geographic areas. Juveniles approximately 2 years of age are most susceptible, but recovery results in immunity for life. Rabies may emerge in near epizootic proportions. Raccoons are somewhat resistant to the disease (Sikes and Tierkel 1960), but such immunity is probably insignificant in preventing epizootics. Stansell (1974) studied the internal parasites of coastal raccoons in South Carolina and analyzed the potential for parasite transmission in translocated animals. Kappus et al. (1970) reported high incidence of rabies on Georgia raccoon populations. Verminous pneumonia occurs commonly in raccoons but apparently does not cause extensive mortality.

b. Harvest and Population. Table 8-43 presents harvest data for raccoons in South Carolina for 1975-76. Number of hunters and effort (days) are also presented. An estimated total of 190,763 raccoons were harvested by approximately 23,347 hunters during 263,463 man-days of effort. Harvest data for Georgia are presented in the section on trapping found later in this chapter.

7. Wild Turkey

The wild turkey historically occurred in large numbers in South Carolina and Georgia. However, population levels in both States have been reduced drastically. Restoration work in both States has produced dramatic increases in populations (Simpson 1978, Bevill 1978b).

a. Limiting Factors. Adult turkeys are primarily vegetarians, with animal foods comprising less than 10% of their diet (Korschgen 1967). Chicks and poults, however, are largely insectivorous, and complement animal food with soft fruits, green vegetation, and mushrooms (Bailey and Rinell 1967). Turkeys are opportunistic feeders, and their diet varies seasonally with availability of food. Natural foods include acorns, beechnuts, dogwood, muscadine grape and black cherry, greenbrier, black gum, pine seeds, hickory, holly, and nutgrass tubers, as well as mixed greens, grass seeds, and insects (Martin et al. 1951, Bailey and Rinell 1967, Korschgen 1967). Animal matter, in the form of fiddler crabs and small frogs, seems to be more prevalent in coastal areas. When available, agricultural crops such as corn, soybeans, peanuts, small grains, and clover augment natural foods. Turkeys are mobile, and the availability of water does not generally constitute a problem in coastal areas.

Suitable turkey habitat includes a scattering of mature mast-producing hardwoods, mainly oaks. Also needed is a mixture of understory plants, like dogwood and black cherry, that provide food and cover. Turkeys make good use of green plants and seed heads found in pastures, fields, roadsides, some regeneration sites and elsewhere. These areas also provide the insects needed by poults to obtain the high quality of protein necessary for their first few weeks of growth. Turkeys need water almost daily and must have easy access to permanent water sources. In good quality turkey habitat, the area will safely support one bird per 30 acres (12 ha) or one flock to about 640 to 800 acres (259 to 324 ha).

Under wild conditions, diseases and parasites usually make their presence felt when populations become too dense for the habitat to support. In such cases, they usually act to put the population back within the capacity of its habitat. The most common parasites are the helminth infestations reported by Maxfield et al. (1963), Hutto (1973), and Prestwood et al. (1975). The blackhead syndrome or enterohepatis is also a devastating disease commonly occurring in Southeastern wild turkeys. Reid (1967) presented an extensive review of the etiology and spread of this disease among domestic turkeys and chickens. Webb (1977) reported that general conditions of wild turkeys statewide in South Carolina continued to be excellent, and that continued collection and study of parasites was not initiated in 1976-77 for that reason.

b. Harvest and Population. Table 8-43 presents turkey harvest data and hunter participation in South Carolina for 1975-76. Turkey hunters have the lowest harvest/man-day of all game species. A total of 9,111 hunters harvested only 7,593 turkeys, less than one per hunter. For Georgia, harvest data are presented in Table 8-36.

Table 8-43. Estimated number of licensed hunters that hunted other game species (excluding those in Tables 8-35, 8-37 through 8-42), number harvested, and number of days spent hunting each species in South Carolina during 1975-76, as stratified by game management and nongame management areas[a], with the average number of game harvested per man-day of hunting in 1975-76 as compared to 1966-67 and 1963-64 surveys. (± data relate to 95% confidence intervals) (Webb 1976).

Species	Type of Area	Hunters	Harvest	Days	Avg. No. Game Killed Per man-day hunted[b] 1975-76	1966-67	1963-64
Ducks	Management Area	9,301(±12,080)	71,370(± 44,338)	45,176(±16,341)	1.58		
	Nonmanagement Area	38,722(±11,162)	420,057(±104,652)	247,708(±36,687)	1.70		
	Statewide Total[c]	46,694(±10,900)	491,427(±113,654)	292,884(±40,049)	1.68	1.34	1.01
Raccoon	Management Area	7,403(±12,137)	31,509(± 13,757)	55,046(±28,384)	.57		
	Nonmanagement Area	17,653(±11,827)	159,254(± 83,487)	208,417(±83,318)	.76		
	Statewide Total[c]	23,347(±11,651)	190,763(± 85,199)	263,463(±88,548)	.72	.70	.94
Fox Squirrel	Management Area	4,745(±12,216)	15,755(± 8,445)	20,880(± 5,963)	.75		
	Nonmanagement Area	11,009(±12,029)	29,801(± 10,304)	84,847(±46,763)	.35		
	Statewide Total[c]	14,236(±11,931)	45,556(± 12,983)	105,727(±47,360)	.43		
Wild Turkey	Management Area	5,694(±12,188)	2,278(± 1,737)	36,634(±13,748)	.06		
	Nonmanagement Area	3,796(±12,244)	5,315(± 5,907)	26,574(±11,608)	.20		
	Statewide Total[c]	9,111(±12,086)	7,593(± 6,191)	63,208(±20,458)	.12	.13	.19
Opossum	Management Area	2,848(±12,272)	16,514(± 10,797)	19,361(±21,590)	.85		
	Nonmanagement Area	6,074(±12,177)	29,042(± 10,511)	62,449(±48,457)	.47		
	Statewide Total[c]	8,542(±12,103)	45,556(± 14,783)	81,810(±52,623)	.56		
Snipe	Management Area	1,708(±12,306)	9,301(± 7,172)	6,264(± 6,860)	1.48		
	Nonmanagement Area	6,074(±12,177)	39,481(± 14,105)	16,893(± 6,001)	2.34		
	Statewide Total[c]	7,782(±12,126)	48,782(± 15,669)	23,157(± 8,912)	2.11		
Woodcock	Management Area	1,519(±12,312)	5,125(± 3,364)	3,417(± 1,562)	1.50		
	Nonmanagement Area	6,264(±12,171)	24,676(± 10,400)	25,815(±10,357)	.96		
	Statewide Total[c]	7,403(±12,137)	29,801(± 10,888)	29,232(±10,658)	1.02		
Marsh Hen	Management Area	949(±12,328)	10,440(± 15,861)	2,278(± 1,817)	4.58		
	Nonmanagement Area	4,556(±12,222)	90,351(± 36,774)	12,718(± 3,938)	7.10		
	Statewide Total[c]	5,505(±12,194)	100,791(± 39,959)	14,996(± 4,269)	6.72	3.90	2.80
Gray Fox	Management Area	569(±12,340)	1,898(± 1,336)	11,769(±21,875)	.16		
	Nonmanagement Area	4,366(±12,227)	16,324(± 9,235)	37,773(±23,410)	.43		
	Statewide Total[c]	4,935(±12,211)	18,222(± 9,280)	49,542(±30,532)	.37		

Table 8-43. Concluded

Species	Type of Area	Hunters	Harvest	Days	Avg. No. Game Killed Per man-day hunted[b] 1975-76	1966-67	1963-64
Bobcat	Management Area	949(±12,328)	1,519(± 454)	1,708(± 1,484)	.89		
	Nonmanagement Area	1,708(±12,306)	1,898(± 1,173)	10,060(±10,594)	.19		
	Statewide Total[c]	2,657(±12,278)	3,417(± 1,268)	11,768(±10,831)	.29		
Red Fox	Management Area	190 NP[d]	NP NP	NP NP	NP		
	Nonmanagement Area	2,467(±12,284)	3,796(± 2,480)	7,213(± 4,140)	.53		
	Statewide Total[c]	2,657(±12,278)	4,935(± 2,975)	7,403(± 4,188)	.67		

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a. Sample size relating to these species was insufficient for stratification by types of licenses.

b. Data on kill per man-day obtained only on total game harvest for some species in 1966-67 and 1963-64 surveys, with several species not included in the previous surveys.

c. Statewide total number of hunters includes only once the number of hunters that hunted each species on both management and nonmanagement areas while the harvest and man-days hunted data for each species are actual totals from hunting on both types of areas.

d. NP - non-projectable.

8. Feral Hog

The domestic hog was introduced to this country by early explorers (Towne and Wentworth 1950, Lewis 1907). Those animals that escaped domestication are the ancestors of today's feral hogs. As agriculture spread in the Southeast, where free-range practices were widespread, hogs became common in the forests and are now geographically widespread (Wood and Lynn 1977).

European wild boars (*Sus scrofa cristatus*) were introduced for sport hunting in the North Carolina mountains in early 1900 (Roark 1977). The South Carolina feral hog populations, however, are most probably pure strains of domestic hogs reverted to the wild, since no records exist of introductions of the European wild boar to this state (D. N. Roark, 1977, South Carolina Marine Resources Division, Charleston, pers. comm.). In Georgia, several coastal islands received introductions of this exotic species to increase sporting value of existing feral herds (Hanson and Karstad 1959). Georgia's hogs could be either pure feral animals or descendants (hybrids) of European-born feral hogs.

a. Limiting Factors. Food habits of the feral hog have been documented in the past, but recently a systematic seasonal study was completed in South Carolina. Roark (1977) studied stomach contents of 92 feral hogs collected near Georgetown, South Carolina. His results show a wide variety of food items, with vegetation being by far the most preferred general food category (Table 8-44). Fruits were dominant during fall (77.6%) and winter (83.7%); in spring, herbage was preferred (51.4%); and during summer, fruits and roots were the main diet items (35.8% and 38.0%, respectively). Hanson and Karstad (1959) studied the contents of about 20 stomachs from Butlers Island, Georgia, during the winter of 1956-57 and found only plant remains. In the spring and summer of 1958, 22 stomachs from Liberty County, Georgia, were also studied; as in Roark's (1977) study, vegetable items made up the major proportion of the contents (Hanson and Karstad 1959). Although not presenting proportion estimates, Hanson and Karstad (1959) state that remains of fiddler crabs, earthworms, insects, frogs, snakes, turtles, and rodents were found.

Habitat preferences of the feral hog vary with seasonal food supply between bottomland hardwoods and upland pines (Sweeney 1970). The one factor necessary in both habitats is dense underbrush, which provides escape cover.

Effects of wild hogs on flora and fauna of southern forests were reported by Wood and Lynn (1977). They surveyed biologists, foresters, and land managers for 11 Southeastern States (including South Carolina and Georgia). The results of their questionnaire are presented in Table 8-45.

There are presently no natural predators of the wild hog other than man. A wide variety of parasites and diseases, however, have been recorded. Ascarid worms and other nematodes, ringworms, kidney worms, ticks, screwworms, anthrax, vesicular stomatitis, pseudo rabies, and bacterial infections were recorded by Hanson and Karstad (1959) from feral hogs in Georgia. The first report of brucellosis among feral hogs in the United States was made by Wood et al. (1976) in South Carolina.

b. Harvest and Population. Few data have been gathered concerning populations of feral hogs. Roark's (1977) harvest data from Hobcaw Barony, near Georgetown, South Carolina are presented in Table 8-46. Brisbin et al. (1977) compared morphology between a South Carolina and Georgia population but presented no population data. Wood and Lynn (1977) present population estimates based upon response to questionnaires for Georgia and South Carolina (Table 8-47).

B. TRAPPING

Trapping can be a highly emotional issue. While this debate can at times be fierce, animal trapping is an important wildlife management tool. Laurie (1978b) states that the emotionalism of trapping comes from an anthropomorphic concern for individuals. But while the individual animal may suffer in a trap, the overall population of that particular species, and man as well, may benefit from trapping. By necessity, professional wildlife managers concentrate on entire populations and seldom have the time or resources necessary to deal with individuals. In general, there is no need to deal with individuals in wildlife management except in situations concerning endangered species.

Data concerning furbearing animal populations and their harvest are limited. Tables 8-48 and 8-49 present available data for South Carolina. Tables 8-50 through 8-52 present available data for Georgia. South Carolina is in the process of upgrading its system for data acquisition concerning trapping and population estimates for furbearing species.

1. Terrestrial Furbearers

a. Opossum. In South Carolina and Georgia, the opossum occurs statewide. Greatest abundance is found in low, tangled woodlands that are characteristic of stream bottoms (Golley 1966). Opossum dens are in hollow trees and logs that are

Table 8-44. Percent composition, based on the dry weight and percent frequency of occurrence, of categories of ingesta found in the stomachs of 92 feral hogs collected at Hobcaw Barony, South Carolina, between 22 July 1975 and 6 August 1976 (Roark 1977).

	Fall (18)[a]		Winter (25)		Spring (23)		Summer (26)	
Categories of Ingesta	Percent Composition[b]	Percent Frequency[c]	Percent Composition	Percent Frequency	Percent Composition	Percent Frequency	Percent Composition	Percent Frequency
Fruits	77.6	94	83.7	91	26.0	62	9.2	54
Acorns	43.8	78	79.8	88	24.2	65	T[d]	8
Hickory Nuts	6.5	33	3.9	2	1.8	1	0.7	6
Tupelo seed	27.3	56	T	8	0.0	0	5.2	12
Muscadines	0.0	0	0.0	0	0.0	0	3.3	8
Herbage	15.9	100	9.5	100	51.4	100	35.8	100
Grass	12.6	78	7.3	88	34.5	87	12.8	73
Dried leaves/pine needles	0.4	68	0.2	68	0.2	70	0.9	88
Unidentified herbage	2.9	39	2.0	32	16.7	56	22.1	77
Roots	3.0	44	2.2	83	20.0	86	38.0	95
Fungi	2.1	67	0.8	78	2.9	57	11.7	76
Invertebrates	0.6	83	2.5	96	2.8	62	2.7	95
Vertebrates	0.7	33	1.2	13	2.8	24	2.5	19
Mammals	0.4	28	0.7	16	1.2	15	1.0	23
Birds	0.0	0	0.1	4	0.0	0	0.0	0
Snakes	0.1	6	0.0	0	0.8	4	0.2	11
Lizards	0.0	0	0.4	4	0.8	8	0.2	4
Frogs	0.2	6	0.0	0	0.0	0	1.1	4

a. Sample size.
b. Percent of the aggregate dry weight of identifiable ingesta in all hogs collected during that season.
c. Percept of the total number of stomachs during that season containing the food item.
d. Trace (less than 0.1%).

Table 8-45. Effects of feral hogs on flora and fauna of forest lands in South Carolina and Georgia, as determined through an opinionnaire (Wood and Lynn 1977).

Hog effect	Respondents with an opinion	Respondents ratings of hog effects			
		Important	Minor	Nonexistent	Beneficial
		percent			
Plants					
Root damage to mature trees	144	5.6	53.5	40.3	0.6
Sapling girdling	138	7.9	49.3	42.8	0.0
Longleaf seedling damage	123	16.2	28.5	55.3	0.0
Loblolly seedling damage	128	10.9	39.1	50.0	0.0
Slash seedling damage	121	6.6	40.5	52.9	0.0
Hardwood seedling damage	138	18.9	52.9	27.5	0.7
Pond Pine seedling damage	104	3.9	17.3	77.8	1.0
Pine seed consumption	116	13.0	50.0	37.0	0.0
Hardwood seed consumption	145	50.3	35.9	10.3	3.4
General soil disturbance	147	28.6	40.8	7.5	23.1
Wildlife					
Turkey nest predation	120	35.0	34.2	30.8	0.0
Turkey poult predation	112	9.8	45.6	44.6	0.0
Quail nest predation	113	20.4	51.3	28.3	0.0
Quail poult predation	110	9.1	50.0	40.9	0.0
Songbird nest predation	116	10.4	49.1	40.5	0.0
Rabbit nesting predation	107	12.2	57.0	30.8	0.0
Predation on mice and voles	98	8.2	51.0	27.5	13.3
Predation on snakes	117	20.5	53.0	9.4	17.1
Competition for food w/deer	146	44.5	43.2	11.6	0.7
Competition for food w/turkeys	143	48.9	35.0	16.1	0.0
Competition for food w/squirrels	146	47.2	41.8	11.0	0.0

Table 8-46. The number of feral hogs, by age and sex classes in each season, collected at Hobcaw Barony, South Carolina, between 22 July 1975 and 6 August 1976 (Roark 1977).

Seasons[a]	Age Classes (Years)													
	0.0 - 0.5		0.5 - 1.0		1.0 - 2.0		2.0 - 3.0		3.0 +		Unknown		Total	
	M[b]	F[c]	M	F	M	F	M	F	M	F	M	F	M	F
Winter	5	5	0	1	5	4	0	1	2	2	1	1	13	12
Spring	1	5	0	1	1	2	8	1	3	4	0	1	13	10
Summer	0	1	4	1	4	3	2	5	2	2	2	0	14	12
Fall	0	0	3	0	4	1	2	2	2	3	1	0	12	6
Totals	6	5	7	3	14	10	12	9	9	11	4	2	52	40

a. Seasons defined as: winter (Dec., Jan., Feb.), Spring (Mar., Apr., May), Summer (June, July, Aug.), Fall (Sept., Oct., Nov.).
b. Male hogs.
c. Female hogs.

Table 8-47. Sightings and condition of wild hog populations for Georgia and South Carolina (Wood and Lynn 1977).

	SOUTH CAROLINA (Percent of hog-inhabited area)	GEORGIA (Percent of hog-inhabited area)
Hog sightings		
Frequent	22	52
Infrequent	52	44
Not indicated	26	4
Hog population level		
Increasing	31	4
Decreasing	5	52
Stable	39	44
Not indicated	25	0

Table 8-48. Two-year summaries of harvest data for commercial furbearing species in South Carolina, ranked by harvest total (South Carolina Wildlife and Marine Resources Department, Game Management Section, 1978, unpubl. data).

Species	No. of Pelts Tagged		Harvest Total
	1975-76	1976-77	
Raccoon	23,763	19,405	43,168
Opossum	1,758	1,310	3,068
Gray fox	1,157	991	2,148
Muskrat	1,786	249	2,035
Otter	783	476	1,259
Red fox	425	235	660
Beaver	--	306	306
Mink	137	53	190
Bobcat	--	23	23

secure and well-insulated for winter. Food habits vary with seasonal availability of food. The opossum is omnivorous. Fruits and insects are probably the most important food items. Other common foods are carrion of rabbit, squirrel, and other mammals; reptiles; amphibians; birds and their eggs; landsnails and crayfish. In South Carolina, the opossum ranks second in harvest among commercial furbearing species (Table 8-48). In Georgia, it ranks first in harvest and eighth in economic return (Table 8-52).

b. Raccoon. This species was discussed in the hunting section of this chapter. The raccoon ranks first in harvest among commercial furbearing species in South Carolina (Table 8-48). In Georgia, it ranks second in both harvest and economic return (Table 8-52).

c. Fox. The gray fox and red fox are trapped for their pelts in South Carolina and Georgia. Golley (1966) reports that the red fox was probably introduced to South Carolina and Georgia from more western States. Preferring more open areas, this species is trapped more frequently on the uplands than near heavily wooded bottomland habitats. The gray fox, on the other hand, reaches greatest

Table 8-49. Number of licensed trappers and buyers and generated revenue from furbearing species for South Carolina from 1969-70 through 1976-77 (South Carolina Wildlife and Marine Resources Department, Game Management Section, 1978, unpubl. data).

Year	No. Trappers	No. Resident Buyers	No. Nonresident Buyers	Licensed Revenue	Tag Revenue
1969-70	136	10	3	$1,910.00	$2,464.60
1970-71	105	6	2	$1,400.00	$ 923.70
1971-72	81	6	3	$1,260.00	$1,169.65
1972-73	64	10	3	$1,190.00	$2,494.60
1973-74	203	13	2	$2,555.00	$4,398.85
1974-75	215	16	2	$2,750.00	$4,626.05
1975-76	169	18	3	$2,440.00	$5,143.85
1976-77	425	43	5	$5,755.00	$8,782.70

Table 8-50. Reported harvest data for commercial furbearing species in Georgia for the 1977-78 trapping season, ranked by total harvest (Odom and Daws 1978).

SPECIES TRAPPED	TOTAL HARVEST
Opossum	19,602
Raccoon	18,339
Fox	12,848
Muskrat	10,971
Beaver	5,133
Mink	1,331
Skunk	1,137
Otter	1,211
Bobcat	1,068
Coyote	155
Other	54

Table 8-51. Economic value of the Georgia fur harvest, 1977-78 season (Odom and Daws 1978).

Species	Number of Hides For Which Payment Was Reported	Total Money Received	Average Price Received
Gray fox	3,500	$87,569.00	$25.02
Raccoon	6,540	52,062.00	7.96
Red fox	584	19,654.00	33.65
Bobcat	342	16,048.00	46.92
Muskrat	2,685	11,099.00	4.13
Otter	402	10,305.00	25.63
Opossum	7,037	9,952.00	1.41
Beaver	1,586	9,712.00	6.12
Mink	387	4,310.00	
Coyote	129	1,342.00	10.40
Skunk	169	637.00	3.77
Other	12	74.00	6.17

abundance in mixed woods and cultivated areas. This animal apparently benefits from the "edge effects" created by man, doing nearly as well on the outskirts of cities or human habitations as it does in less disturbed habitats (Leopold 1959).

Both fox species are opportunistic omnivores. Plant food such as fruits, peanuts and rushes, and animal food such as rabbits, mice, reptiles, insects, and amphibians are common food items.

In South Carolina, the gray fox ranks third in harvest among commercial furbearing species, while the red fox is sixth (Table 8-48). In Georgia, the gray fox also ranks third in harvest, but it is first in monetary return (Table 8-51).

d. Bobcat. The bobcat is the most abundant North American cat, occurring in all 48 contiguous States. Because of the bobcat's secretive nature, information on habitat requirements and population

Table 8-52. Relative importance of species trapped during the 1977-78 trapping season in Georgia (Odom and Daws 1978).

Rank	Estimated Number of Animals Trapped	Estimated Monetary Return
1st	Opossum	Gray fox
2nd	Raccoon	Raccoon
3rd	Gray fox	Red fox
4th	Muskrat	Bobcat
5th	Beaver	Muskrat
6th	Red fox	Beaver
7th	Mink	Otter
8th	Otter	Opossum
9th	Skunk	Mink
10th	Bobcat	Skunk
11th	Coyote	Coyote

density have been scanty to nonexistent. Data on habitat preference are usually inferred from the types of prey utilized by this predator, such as the small mammals (principally cotton rats) and birds that are characteristically found in early to mid-successional areas (Kight 1962). Golley (1966) reports that the bobcat frequents dense brush, bottomlands and swamps, and feeds in more open country.

In South Carolina, only 23 bobcats were trapped during the 1975-76 and 1976-77 seasons, ranking ninth in harvest among commercial furbearing species (Table 8-48). In Georgia, the bobcat ranks tenth in harvest and fourth in economic return (Table 8-52).

2. Aquatic and Semi-aquatic Furbearers

a. Mink. Little data on the mink exist for South Carolina and Georgia. This species is semi-aquatic and is encountered along streams, rivers, and salt marshes on the coast (Golley 1966). They den in, or under, fallen logs and hollow stumps. Food habits are mainly aquatic, with fish, crabs, crayfish, and frogs comprising the primary food sources. They are also known to consume rats, birds, mice, and rabbits.

The mink ranks eighth in total harvest among commercial furbearing species in South Carolina (Table 8-48). In Georgia, it is seventh in harvest and ninth in monetary return (Table 8-52).

b. Otter. The river otter is a large aquatic mammal frequenting rivers, ponds, lakes, and salt marshes (Golley 1966). The otter is common in coastal areas of both States. Food items consumed are primarily fish and other aquatic animals such as crustaceans, insects, and clams. The otter ranks fifth in harvest among commercial furbearers in South Carolina (Table 8-48), while in Georgia it is eighth in harvest and seventh in economic return (Table 8-52).

c. Muskrat. The muskrat is a large rodent that is modified for aquatic life (Golley 1966). Although occasional unconfirmed sightings are reported, this species is generally believed to be absent from coastal South Carolina and Georgia (Jenkins 1953, Golley 1966). Statewide, however, it ranks fourth in total harvest among commercial furbearing species in both South Carolina and Georgia (Tables 8-48 and 8-52).

d. Beaver. The beaver rarely occurs in coastal areas of South Carolina (Golley 1966) and Georgia (Jenkins 1953, Hicks 1977). Historically, the beaver was common in both States, but its demand by settlers almost exterminated it. Restocking efforts in both States have succeeded in re-establishing populations. Distribution of beavers in coastal Georgia is primarily along the Savannah and Altamaha rivers (Golley 1966, Godbee and Prince 1975, Hicks 1977). In South Carolina, beaver populations have increased over the last 10 years in the Savannah and Pee Dee river drainages, and currently they are distributed in 28 of the 46 counties of South Carolina (Woodward et al. 1978). The beaver is both semi-aquatic and a strict vegetarian. Beaver food consists of several species of woody and aquatic plants that are utilized in varying amounts depending upon the season and locality. Preferred food plants include sweet gum, willow, alder, iron wood, dogwood, tulip tree, maple, water-lily, and corn (Hicks 1977). Golley (1966) reports that pine is also consumed. The beaver is ranked seventh in total harvest among commercial furbearing species in South Carolina (Table 8-48), and fifth in Georgia (Table 8-52).

The economic impact of beavers in the study area has not been fully realized. However, on a statewide basis in South Carolina, Woodward et al. (1978) found that the total estimated loss to forestry or agricultural interests attributed to this species exceeded the benefits by $225,000. Hill (1976) reported on the status of beavers in 10 Southeastern States, and presented minimum estimates of $7 million damage as a result of beaver activity during a 10-year period on flooded timber lands. Although the beaver is considered a pest by many land owners, the management of beaver pond habitat can produce beneficial results especially for other wildlife species (Beard 1953, Speake 1955, Arner 1963, Arner et al. 1966).

CHAPTER NINE

RECREATION

I. INTRODUCTION

Within recent years, there has been an increasing demand for outdoor recreational opportunities. Several factors, including more people with more leisure time and a higher standard of living, have helped to create this demand. New roads, parking areas, campgrounds, vacation homes, and marinas, to name but a few of the facilities needed to meet this increasing recreational demand, require large amounts of land, consume tax dollars, and are changing the character of many coastal areas.

In addition to increased demand for recreation, there have been substantial changes in people's recreational habits and patterns. For example, more people are now taking nonsummer vacations. Also, many recreational activities have been affected by technological change; for example, portable equipment and facilities now make possible instant, movable recreational areas. Changes in recreational tastes are illustrated by the increased participation in camping. Proof that the public is receptive to new and unique recreational approaches is seen in legislative actions, voter-supported bond issues, activity attendance, equipment sales, and the many citizen suggestions to recreation-oriented agencies (U.S. Department of Interior, Bureau of Outdoor Recreation 1973).

Expenditures on recreational products and equipment, recreational trips, and second homes exceeded $105 billion during 1974, and funded about one out of every 20 jobs in the country (U.S. Department of Interior, Bureau of Outdoor Recreation 1975). The ocean-recreation market comprises about one-third of outdoor recreational expenditures (Winslow and Bigler 1969). Based on these statistics, it is apparent that coastal tourism and recreation have a significant impact on coastal economic development.

Swimming, boating, hunting, and fishing are the traditional recreational activities of the coastal areas. In recent years, a number of new activities, including surfing, water skiing, scuba diving and snorkeling, have become extremely popular. Other activities that are enjoyed and vigorously pursued in coastal areas, where opportunities exist, include beachcombing, bird watching, hiking, bicycling, picnicking, camping, nature study, photography, and general sightseeing.

Private contributions to outdoor recreation constitute a complex array of enterprises, groups, organizations, and individual efforts touching practically every aspect of outdoor recreation. The involvement ranges from family-owned and operated cabin resorts to the corporation-managed hotel chain; from providers of recreational facilities or services to manufacturers of recreational equipment.

According to the South Carolina Department of Parks, Recreation, and Tourism (DPRT) (1975a), private outdoor recreation is grouped by operation into two categories: profit enterprises (commercial) and non-profit recreation operations (clubs). The commercial category includes enterprises directly providing outdoor recreational facilities and services to general public and concession operations. The non-profit (club) category includes a variety of recreational, religious, military, educational, civic, and industrial organizations which provide recreational services to their members.

Additionally, the DPRT reported that private enterprise provides the larger portion of selected outdoor recreational facilities and services in South Carolina in number of operations (82.1%), while the public sector provides only 17.9% of such facilities. The largest portion of the private enterprises is service facilities (accommodations), and the remaining enterprises are the primary recreational facilities. The primary recreational facilities use a total of 397,374 acres (160,815 ha). Many of these facilities are located in the coastal region of South Carolina and specific information on them can be found in the appropriate sections of this chapter.

The demand for coastal-oriented recreational opportunities will probably continue to grow more rapidly than the population. The expected move toward saltwater and large freshwater bodies will result from these factors: the increasingly crowded conditions under which people live and play on land, which will cause many to look for less crowded conditions for recreation; rising personal income coupled with increased leisure time and mobility; and the rapid growth of recreational technology, which will introduce new forms of marine sports and opportunities.

Demographers estimate that the U.S. population will approximately double by the year 2000, and that 175 million people will be living in the coastal zone. Recent data indicate that increases in demand for many types of outdoor recreation are far greater than population increases. For example, between 1950 and 1965, while the population was increasing from 152 million to 194 million (a 28% increase), the number of fishing licenses increased from 15.3 million to 24.9 million (a 63% increase), and the number of outboard motors in use more than tripled, rising from 2 million to 6.7 million during this period (University of Rhode Island 1969).

Indications of demand for marine recreation are based on a concept of "occasions of participation" in summer outdoor recreational activities. The overall predicted demand for recreational occasions in the coastal zone by the year 2000 is 4.5 billion (University of Rhode Island 1969).

The increased demand for public marine recreational areas has led to grave problems of overcrowding at the beaches, in the water, and near the shore. Traffic tie-ups are common on highways leading to and from beaches every summer weekend. The coves, harbors, and bays are becoming so crowded with sail boats and motor boats that health and safety hazards have become serious.

In South Carolina, participation in recreational activities in the coastal areas has increased significantly in recent years, and this trend is expected to continue (Table 9-1). In order to provide these coastal recreational opportunities, there must be an increase in the number of recreational facilities. Table 9-2 presents information on facilities requirements for certain types of outdoor recreation in South Carolina's coastal areas.

The coastal area of Georgia still has great potential for increased recreational use. Little of the area's mainland has been fully utilized for recreational purposes. This lack of development is apparent even in areas along rivers and estuaries. The few exceptions are areas near urban centers, especially near Savannah and Brunswick. The recreational resources of the coast that have the greatest potential demand are the beaches on the coastal islands. The recreational assets of the coastal islands include: beautiful beaches, varied natural resources, wildlife sanctuaries, and places of historical significance (Clement 1971).

As reported by the Georgia Department of Natural Resources (1975a,b), increased demands for recreational opportunities are anticipated in Georgia's coastal areas for the following reasons:

1) The population of the eight-county Coastal Area Planning and Development Commission (APDC) region (Effingham, Chatham, Liberty, Long, Bryan, McIntosh, Glynn, and Camden counties) is projected to increase from [illegible] in 1970 to about [illegible] by 1980. The population of the State during this period is projected to increase from 4.6 to 5.3 million. This population increase will, in turn, increase demand for recreation. The median age of the population of the 10-county coastal region (the APDC counties plus Wayne and Brantley counties) in 1980 is expected to be 21.7 years, the lowest of the seven Outdoor Recreation Planning regions in the State. Younger persons participate to a greater extent in recreational activities than older persons.

2) The percentage of the population residing in urban areas will increase in this 10-county coastal region from 57% in 1940 to 74% in 1980.

3) The per capita income in the six coastal counties will increase from $2,568 in 1968 to $4,480 in 1980. The entire State is expected to show a per capita increase from $2,775 to $5,910 during the same period. Equally as important from the standpoint of recreation, the total personal income in Georgia is projected to increase from $5,997 million to $17,215 million from 1960 to 1980. In 1970, Georgia spent $1,883 million on travel-related expenditures. This was a 136.8% increase over the 1961 expenditure of about $795 million.

4) Recreational demand in coastal Georgia has been affected by the completion of Interstate Highway 95 and Interstate Highway 16. It is expected that 43% of the travel on I-95 will be recreation-related. An estimated 14% of the travel on I-16 will be recreation-related.

The best available information concerning future demand for recreation in the Georgia coastal region has been published by the U.S. Department of Interior, Bureau of Outdoor Recreation in Outdoor Recreation, A Legacy for America (1973). The geographical unit employed in this survey was the Federal Bureau of Economic Analysis (BEA) unit. Two BEA units, Savannah, Georgia, and Jacksonville, Florida, cover coastal Georgia (Georgia Department of Natural Resources 1975a).

Data concerning socioeconomic characteristics of the population and prices paid for recreational activities by sample respondents were obtained in a nationwide survey conducted in September, 1972 (Georgia Department of Natural Resources 1975a). The information was then used to compute an estimate of 1972 demand for different recreational activities (Table 9-3). Projections to 1978 for certain socioeconomic characteristics were made, and these projections were then used to compute the projected demand for recreation.

Because the demand estimates are based upon information obtained for BEA units, they should be considered regional demand estimates. Specific statewide local demand estimates were not made in the Bureau of Outdoor Recreation study.

Table 9-1. Annual recreational user-occasions for the coastal areas of South Carolina, with projections for 1972, 1975, 1980, and 1985 (South Carolina Department of Parks, Recreation, and Tourism 1975a).

Visitation Regions	Visits to Historical Cities, Places	Beaches/ Swimming	Commercial Attractions Gardens Amusements	Golfing	Camping	Boating/ Fishing	Watching Sports and Racing	Attending Shows Events Concerts	Horseback Riding	Hunting
1972										
Sub-Region I[a]	4,056,098	28,490,685	8,412,343	1,513,489	4,386,666	2,128,402	542,582	1,673,585	131,191	186,068
Sub-Region II[b]	4,001,414	3,186,716	3,300,105	739,464	674,380	997,580	983,707	913,248	169,919	472,021
Sub-Region III[c]	651,617	2,108,978	196,760	448,294	213,961	527,213	208,255	85,942	291,077	175,165
1975										
Sub-Region I	4,336,579	29,678,547	8,966,183	1,590,567	4,732,629	2,191,387	548,962	1,775,989	133,939	186,426
Sub-Region II	4,265,665	3,334,778	3,461,236	754,391	730,242	1,016,367	993,596	952,152	172,930	476,104
Sub-Region III	672,379	2,149,387	213,422	457,981	223,339	534,824	208,587	87,432	299,150	175,508
1980										
Sub-Region I	4,537,147	30,833,408	9,373,098	1,656,449	4,963,449	2,269,177	565,688	1,854,420	138,374	191,568
Sub-Region II	4,459,490	3,468,875	3,602,626	779,204	776,560	1,049,323	1,023,369	989,437	178,496	490,176
Sub-Region III	697,368	2,219,454	224,124	473,183	232,226	551,548	214,317	90,245	309,629	180,350
1985										
Sub-Region I	4,739,076	31,976,485	9,782,069	1,722,087	5,196,903	2,345,374	581,738	1,933,049	142,681	196,430
Sub-Region II	4,654,313	3,602,068	3,743,294	803,279	803,352	1,081,236	1,051,888	1,026,368	183,881	503,626
Sub-Region III	721,426	2,287,354	234,973	487,950	241,042	567,666	219,732	92,966	319,878	184,929

a. Includes Horry and Georgetown counties.

b. Includes Charleston, Berkeley, and Dorchester counties.

c. Includes Beaufort and Jasper counties.

Table 9-2. Facilities requirements for certain types of outdoor recreation in the coastal areas of South Carolina, with projections for 1972, 1975, 1980, 1985 (South Carolina Department of Parks, Recreation, and Tourism 1975a).

Visitation Regions	Beach[a] Areas (Acres)[b]	Camping (Sites)	Golfing (Holes)	Horseback Riding (Miles)[c]	Hunting (Acres)	Boating/Fishing (Annual Occasion)
1972						
Sub-region I[d]	218	7,976	473	37	46,517	2,128,402
Sub-region II[e]	24	1,226	217	49	118,005	997,580
Sub-region III[f]	16	389	187	83	43,791	527,213
1975						
Sub-region I	227	8,605	497	38	46,607	2,191,387
Sub-region II	26	1,328	222	49	119,026	1,016,367
Sub-region III	16	406	191	85	43,877	534,824
1980						
Sub-region I	236	9,024	518	40	47,892	2,269,177
Sub-region II	27	1,394	229	51	122,544	1,049,323
Sub-region III	17	422	197	88	45,088	551,548
1985						
Sub-region I	245	9,449	538	41	49,108	2,345,374
Sub-region II	28	1,461	236	53	125,907	1,081,236
Sub-region III	18	438	203	91	46,232	567,666

a. The shore of an ocean, lake, or river bank covered by sand or gravel.
b. 1 acre = .4047 ha.
c. 1 mile = 1.6093 km.
d. Includes Horry and Georgetown counties.
e. Includes Charleston, Berkeley, and Dorchester counties.
f. Includes Beaufort and Jasper counties.

II. TOURISM

Tourism is an extremely important component of the recreation industry in coastal South Carolina and Georgia, and has a major economic impact. Spending related to tourism supports people engaged in manufacturing and sales, and all levels of government benefit from tax revenue derived from the tourism industry. Because there is considerable variation in how each State generates and reports its respective tourism-related economic data, no attempt will be made to compare the impact of tourism between the two States.

A. SOUTH CAROLINA

During 1969, tourism was the third largest and the most rapidly expanding industry in South Carolina (U.S. Department of Agriculture 1972). During the early 1970's, tourism became the second largest industry in South Carolina and nearly 80% of tourism expenditures occurred in coastal areas (Table 9-6).

In South Carolina, most of the major tourist attractions are concentrated in three key locations on the coast: the Myrtle Beach/Grand Strand area, the Charleston area, and the Beaufort area. About half of the nonresident visitors in South Carolina are attracted to the coastal area of the State (Table 9-4). The ocean, beaches, and beach resorts are the most popular and important tourist attractions in the State. Other major attractions include historic areas, gardens, and fishing (South Carolina Department of Parks, Recreation, and Tourism 1975a).

A 1974 South Carolina travel survey showed that North Carolina contributes more than 28% of South Carolina's visitors. Ohio, Tennessee, Virginia, and Pennsylvania together contribute 28%, and the remainder is divided among numerous other States (South Carolina Department of Parks, Recreation, and Tourism 1975a).

The beaches are South Carolina's greatest single attraction among the

Table 9-3. Projected percent increase in quantities of outdoor recreational activities demanded in Savannah, Georgia and Jacksonville, Florida areas from 1972 to 1978 (Georgia Department of Natural Resources 1975a).

Activity	Savannah Area	Jacksonville Area	% Increase
Camping in developed camp grounds	9	13	4
Fishing	6	10	4
Riding motorcycles off the road	7	11	4
Nature walks	10	14	4
Walking for pleasure	7	11	4
Bicycling	4	9	4
Water skiing	10	14	4
Other boating	3	17	14
Outdoor pool swimming	7	12	5
Other swimming outdoors	8	12	4
Golf	23	24	1
Playing other outdoor games or sports	0	5	5
Going to outdoor concerts, plays, etc.	11	15	4
Going to outdoor sports events	12	18	6
Visiting zoo, fairs, amusement parks	5	10	5
Sightseeing	6	11	5
Picnicking	6	10	4
Percent change in population	5	9	4
Percent change in family income	8	10	2

varied natural, historic, and man-made resources that have helped to develop tourism into a billion-dollar industry for the State. Tourism and travel-related businesses employ 56,000 South Carolinians throughout the State. In 1975, the State received $60 million in taxes collected from nonresident travelers and vacationers to help finance public services for the people of South Carolina (South Carolina Department of Parks, Recreation, and Tourism 1976a).

The State's record 1975 total of 33 million travelers from out of State included over 11.5 million whose primary destination was within South Carolina. A total of 8.2 million of these nonresident vacationers stayed at hotels, motels, campgrounds, cottages, villas, and other lodging places in the beach area, and accounted for $428,135,900 of the State's overall travel-tourism expenditures of $1,107,000,000. These coastal visitors included 6.1 million persons who stayed at oceanfront lodging places and campgrounds and spend $283,580,000. The 10.3 million visitors to South Carolina's parks in 1975 included 4.3 million who used the four oceanfront State parks (South Carolina Department of Parks, Recreation, and Tourism 1976b).

In terms of market considerations, South Carolina's tourism and recreation growth potential is tremendous. The fact that tourism expenditures increased 90% from 1973 to 1976, that tourism is the State's second largest industry, and that nearly 80% of this spending occurred at

Table 9-4. Percent distribution of visitors and their expenditures in the four major destinations in the South Carolina coastal region, 1972 - 1976 (South Carolina Budget and Control Board 1977).

Major Destination	1972		1973		1974		1975		1976	
	visitors	expenditures	visitors	expenditures	visitors	expenditures	visitors	expenditures	visitors	expenditures
Myrtle Beach	36.1	41.5	36.5	51.1	35.5	56.4	33.7	46.4	33.5	43.6
Charleston	120.0	20.1	13.7	16.9	14.7	15.9	15.8	17.6	17.5	20.0
Hilton Head	1.9	3.7	1.2	5.2	1.9	5.7	2.3	7.3	3.1	10.1
Beaufort	1.7	1.6	1.7	1.2	1.8	1.6	2.0	1.8	1.8	1.6

coastal areas indicates the importance of beaches to the State's economy (Hartzog, Lader and Richards, Inc. 1975).

As Table 9-5 illustrates, residents are far more likely to swim at the coast while vacationing in-State. They prefer to swim in their home State and leave other activities for their out-of-State holidays.

Nonresident participation rates are not directly comparable to resident participation rates because the rates shown for nonresidents represent the percentage of total activities participated in rather than the percentages of visitors participating in that activity. The comparison, however, does serve to show that the most popular South Carolina recreational activities for nonresidents are beach swimming, using commercial facilities, visiting historic places, and camping. The same four activities are very popular with resident vacationers, with two important additions - boating and fishing. Thus, beach access and recreation are crucial to the State's tourism industry. Moreover, the facility requirements of resident and nonresident vacationers in South Carolina are quite similar.

During 1968, the average visitor to South Carolina spent between 1.8 and 2.0 days in the State (South Carolina Water Resources Commission 1970). By 1972, the average length of stay in South Carolina by nonresident tourists was 3.7 days, which was quite low however, compared with other States (Hartzog, Lader and Richards, Inc. 1975). Seasonal variation is also a factor: summer visits have the longest duration (averaging 4.2 days), followed by spring (4.1 days), fall (3.1 days), and winter (2.1 days).

South Carolina residents vacationing in-State spend an average of 6.4 nights away from home on a vacation trip. The average number of nights away from home on a weekend trip is 2.4 (Hartzog, Lader and Richards, Inc. 1975).

The average party size for vacationers in South Carolina is 3.9. Similarly, the typical auto vacation travel party consisted of four persons, usually two adults and two children (Hartzog, Lader and Richards, Inc. 1975).

Pleasure and outdoor recreation are the major trip purposes of South Carolina travelers, accounting for 54.7% of the total trips. Although visiting friends and relatives is the major reason for travel nationally, that category ranks second in South Carolina and accounts for only 28.2% of the total trips per person. The third major reason for travel, business, accounts for only 8.8% of the total trips per person (Hartzog, Lader and Richards, Inc. 1975).

South Carolina coastal businessmen have a large stake in the United States tourism and recreation market. One-sixth of the nation's travel consists of trips along the South Atlantic coast.

It was estimated that $250 million of South Carolina's $337 million traveler

Table 9-5. South Carolina vacation activity participation for South Carolina residents and for nonresidents visiting South Carolina (Hartzog, Lader and Richards, Inc. 1975).

	RESIDENTS		
Activity	Vacation In-State %	Vacation Out-of-State %	Non-residents %
Visiting historic places	31.6	30.0	10.3
Swimming at beaches	84.5	41.5	34.2
Commercial attractions	13.4	39.5	20.5
Golfing	0.3	4.8	3.3
Camping	25.8	16.7	12.3
Boating/Fishing	60.6	33.7	9.6
Watching sports	6.3	8.3	4.6
Attending shows/concerts	7.8	20.1	- -

spending during 1968 occurred in the coastal region. In the Myrtle Beach area alone, tourist and traveler spending exceeded $100 million (South Carolina Water Resources Commission 1970).

In 1974, in addition to South Carolinians' own beach recreation, 30.9 million nonresidents visited and spent $896.2 million in the State. These expenditures accounted for 8% of all retail trade and service receipts in the State (Hartzog, Lader and Richards, Inc. 1975).

During 1976, it was estimated that travel and tourism were a $1.7 billion industry in South Carolina (South Carolina Department of Parks, Recreation, and Tourism 1978). The coastal counties accounted for 49% of these total travel expenditures (Table 9-6). More than two-thirds of all travel expenditures came from nonresident automobile travelers. Recent data show that spending by these out-of-State automobile travelers increased by 197% in the period from 1972 through 1977 (Table 9-7).

Businesses that cater to travelers are not the only ones that profit from beach recreation. Travel and recreation revenues pass quickly to other individuals and industries. The beach user's dollar, spent for food, lodging, entertainment, or supplies, flows through wholesale outlets, distributive services, financial institutions, manufacturing industries, and agriculture. In this commercial process, the beach user's dollar is multiplied, generates additional trade, creates jobs, and fosters community development.

Income multipliers for the travel industry range from 1.10 to 1.24, while employment multipliers in this industry range from 1.04 to 1.76 (Hartzog, Lader and Richards, Inc. 1975). For example, every $100,000 spent on food generates approximately $110,000 in total income. As a result of these expenditures, approximately 11 persons are employed directly by the food industry and eight more people are employed in other businesses.

The economic importance of tourism and recreation to beach communities and the State as a whole cannot be overstated. South Carolina's beaches have been a primary foundation for tourism, the State's second largest industry. Optimizing public beach access and recreation, therefore, promises substantial benefits to both the private and public sectors of the State's economy.

B. GEORGIA

Tourism plays an important role in the coastal economy of Georgia. During the period from 1961 through 1969, the increase in the amount of vacation/recreation travel in the coastal area of Georgia was significant (Table 9-8). Projections indicate that this trend is expected to continue. An analysis of data on Georgia travel patterns reveals that from 15% to 20% of the total number of in-State travelers are going to the coast. Between 10% and 13% of out-of-State vacation/recreation travelers are going to the coast. When these percentages are applied to data and projections for the State of Georgia, specific estimates for coastal vacation/recreation travel on the coast increase from 1,945,994 persons in 1961 to an estimated 4,919,785 persons in 1975. The number of travelers is projected to increase over the 1969 level by 82% (to 7,314,347 travelers) by 1985 (Georgia Department of Natural Resources 1975a).

The great majority of travelers passing through coastal Georgia are coming from the Northeastern United States and are going to Florida, and most of these travelers have vacation/recreation activities as their purpose. The average traveling group size is 2.7 persons and most of the trips last 1 to 2 weeks. The vast majority travel by automobile and over half of them stay in hotels and motels. The majority of travelers prefer to travel long distances via the interstate routes, but many also like to take side trips. Over 75% of the travelers would take a more scenic route if it was available. Most of the travelers based the selection of their vacation location on such factors as climate, new areas to explore, and sites and attractions, all of which exist in coastal Georgia (Wilbur Smith and Associates 1975).

Table 9-9 presents travel industry economic data on a county-by-county basis for the Georgia Sea Island Coastal Region. The travel industry, as defined by Hein (1978), includes businesses that serve the traveling public either principally or with great frequency, thereby receiving the greater portion of their receipts from the travel dollar. These firms include lodging, eating and drinking places, and entertainment services. The importance of the automobile in Georgia travel has necessitated the addition of businesses that provide automotive services. These firms include automotive service stations, repair shops and garages, parking lots, and related automobile accessory dealers.

The only study that details the economic impact of the tourism/recreation industry in the coastal area of Georgia is one by Floyd and Simmons (1972). This study considers the identification of economic and social benefits resulting from the utilization of coastal land in the development process, with special attention given to Jekyll Island. The study covers the following: 1) a description of recreational land as a resource and

Table 8-4. Impact of travel expenditures on South Carolina coastal counties during 1976 (South Carolina Department of Parks, Recreation, and Tourism 1978).

County	Ranking[a]	Total Travel Expenditures (Thousands of dollars)	Travel Generated Payroll (Thousands of dollars)	Travel Generated Employment (Jobs)	State Tax Receipts (Thousands of dollars)	Local Tax Receipts (Thousands of dollars)
Beaufort	[illegible]	[illegible]	13,336	2,806	3,253	443
Berkeley	[illegible]	[illegible]	1,305	266	333	31
Charleston	2	[illegible]	64,416	9,643	12,721	1,150
Colleton	[illegible]	[illegible]	2,716	567	682	62
Dorchester	[illegible]	[illegible]	695	129	209	16
Georgetown	[illegible]	[illegible]	3,632	734	908	82
Horry	1	[illegible]	87,331	18,571	21,391	1,829
Jasper	[illegible]	[illegible]	3,965	840	972	68
Coastal Area Total		[illegible]	177,412	33,574	40,469	3,681
State Total		[illegible]	349,509	66,264	82,500	8,419

a. Ranking of all South Carolina counties by expenditure levels.

Table 9-7. Expenditures by nonresident auto travelers in South Carolina, 1972 - 1977 (South Carolina Department of Parks, Recreation, and Tourism 1978).

	1972	1977	% Change
Total Auto Travelers[a]	$ 26,285,018	$ 39,586,202	51%
Average Length of Stay	2.6 days	2.8 days	8%
Expenditures - All Auto Travelers	473,130,323	1,406,893,619	197%
Average Expenditures Per Person	$18	$36	100%
Total Visitors[b]	8,024,815	14,290,619	78%
Average Length of Stay[c]	4.74 days	4.84 days	2%
Expenditures of Visitors	286,243,845	1,085,332,894	279%
Average Expenditure Per Person	$36	$76	111%
Total "Pass Through" Travelers[d]	18,260,203	25,295,583	38%
Average Length of Stay	1.57 days	1.46 days	7%
Expenditure of Pass Through Travelers	186,886, 478	321,560,725	72%
Average Expenditure Per Person	$10	$13	30%

a. Person visits. Not all separate individual travelers.
b. Those travelers with South Carolina destinations.
c. 1972 not available. 4.74 = 1973.
d. Those travelers with non-South Carolina destinations.

Table 9-8. Number of vacation/recreation travelers in the coastal counties of Georgia from 1961 - 1969, with projections for 1975, 1980, and 1985 (Georgia Department of Natural Resources 1975a).

	Georgia Residents	Non-Georgia Residents	Non-Georgia Residents % of Total	Total
1961	1,827,263	119,769	6.1	1,947,032
1962	1,962,660	127,686	6.1	2,090,346
1963	2,017,920	131,391	6.1	2,149,311
1964	2,168,775	140,288	6.1	2,309,063
1965	2,369,187	156,478	6.2	2,525,665
1966	2,840,727	218,339	7.1	3,059,066
1967	2,961,707	185,333	5.8	3,147,040
1968	3,107,850	255,671	7.1	3,363,521
1969	3,518,617	278,760	7.3	3,797,377
1975	4,390,450	328,330	6.7	4,718,780
1980	5,827,160	429,880	6.8	6,257,040
1985	6,780,843	521,386	7.1	7,302,229

Table 9-9. Economic data for the Georgia travel industry, by county, in the Sea Island Coastal Region of Georgia, 1977 (Hein 1979).

Bryan	Firms	Sales ($)	Employment	Wages ($)
Eating/drinking	22	1,115,235	---	---
Lodging	7	3,320,302	167	750,855
Recreation/amusement	1	8,993	---	---
Automotive				
Service stations	23	7,850,135	145	791,493
Tire/battery/access	3	86,510	---	---
Auto repair/garages	6	109,597	---	---
Total	62	12,490,773	385	1,823,084
Camden				
Eating/drinking	33	1,032,114	50	132,337
Lodging	10	303,054	18	67,844
Recreation/amusement	4	23,322	---	---
Automotive				
Service stations	25	2,938,624	63	316,564
Tire/battery/access	7	525,067	21	205,160
Auto repair/garages	3	130,839	---	---
Total	83	5,062,417	160	765,175
Chatham				
Eating/drinking	395	54,506,591	3,973	15,900,671
Lodging	58	21,829,163	1,336	6,299,264
Recreation/amusement	47	5,163,759	371	1,898,226
Automotive				
Service stations	173	39,177,453	737	3,786,177
Tire/battery/access	69	10,814,867	301	2,687,142
Auto repair/garages	88	450,235	494	4,182,629
Total	849	141,228,637	7,212	34,754,109
Effingham				
Eating/drinking	8	587,081	22	74,850
Lodging	---	---	3	19,258
Recreation/amusement	1	12,919	---	---
Automotive				
Service stations	21	3,006,712	18	77,328
Tire/battery/access	6	744,899	5	31,453
Auto repair/garages	5	144,295	---	---
Total	41	4,495,940	56	225,777
Glynn				
Eating/drinking	132	15,977,787	1,381	5,483,208
Lodging	33	19,039,767	1,799	10,462,553
Recreation/amusement	18	1,688,826	239	1,450,928
Automotive				
Service stations	63	12,421,713	103	656,226
Tire/battery/access	20	4,977,953	90	878,869
Auto repair/garages	27	813,456	92	702,244
Total	305	55,140,710	3,704	19,634,028
Liberty				
Eating/drinking	58	6,432,484	512	1,782,831
Lodging	3	676,275	57	180,182
Recreation/amusement	5	265,235	---	---
Automotive				
Service stations	24	3,993,893	81	439,930
Tire/battery/access	10	1,540,738	32	248,004
Auto repair/garages	11	381,510	---	---
Total	113	13,278,458	779	3,180,140
McIntosh				
Eating/drinking	29	975,604	23	89,328
Lodging	8	1,943,087	111	487,851
Recreation/amusement	6	74,698	---	---
Automotive				
Service stations	11	2,698,054	22	127,661
Tire/battery/access	4	632,987	---	---
Auto repair/garages	1	8,691	---	---
Total	59	6,333,121	162	738,056

the methodology necessary to determine the economic impact of such a resource; 2) the process by which recreational land utilization affects the local economy in employment, income, population and migration patterns, and housing; 3) the classification of demand for coastal area recreational facilities; and 4) as inter-island comparative analysis of land use patterns.

Although the future is uncertain, demand for tourism and recreational facilities are expected to increase significantly within the next 10 years in the coastal region of Georgia (Georgia Department of Natural Resources 1975a). For example, one study has estimated that within 15 years of opening, Cumberland Island National Seashore will provide $81 million in expenditures by the National Park Service and the public to the economies of Glynn and Camden counties, thereby creating 915 new jobs and causing a population increase in these two counties of 2,745 persons (Georgia Department of Natural Resources 1975a).

III. NATIONAL PARKS, MONUMENTS, AND SEASHORE

Within the coastal regions of South Carolina and Georgia, there are five areas under the National Park System (Brooks et al. 1977). Two of these areas are located in South Carolina (Fort Moultrie National Park and Fort Sumter National Park), while the remaining three areas (Fort Pulaski National Monument, Fort Frederica National Monument, and the Cumberland Island National Seashore) are located in Georgia (Atlas plates 27, 29, and 31 - 40. These areas have been set aside by Congress in order to preserve them because of their recreational, natural, and cultural significance. All of these sites are popular tourist attractions that play an important role in the coastal economy.

A. FORT MOULTRIE

Fort Moultrie, located on Sullivans Island, has been the site of several coastal fortifications during the Nation's history. The first fort was involved in one of the most decisive engagements during the American Revolution. A later fortification on this same site played an important part during the Civil War. Many cannons, other guns, and pieces of ammunition are now on display in the fort and a new visitors' center has recently been completed.

B. FORT SUMTER

Fort Sumter, located in Charleston Harbor, was one of a series of coastal fortifications built by the United States after the War of 1812. This fort played a prominent role in the Civil War. There is a museum located within the fort, and tour boats make daily trips to the fort, which can only be reached by water.

C. FORT PULASKI

Fort Pulaski, a famous Civil War fort, is located on the south side of the Savannah River in Chatham County, Georgia. Fort Pulaski and the surrounding area, some 5,500 acres in all, are managed by the National Park Service as a National Historic Monument (Georgia Department of Natural Resources 1975a). The primary recreational uses of the area are historic appreciation and picnicking.

According to available visitor statistics, the use of Fort Pulaski as a recreational destination has increased in past years. Between 1971 and 1974, visitor use of Fort Pulaski increased 104%; however, the 1974 visitation rate (293,332) was still considerably below the peak of 461,391 visitors during 1969. Peaks in visitor use occur at Fort Pulaski in the spring (March and April) and in the summer months of July and August (Georgia Department of Natural Resources 1975a). Slightly more than one-half of the annual visits to Fort Pulaski occur during the summer months.

D. FORT FREDERICA

Fort Frederica, noted for its pre-Revolutionary history, is located adjacent to St. Simons Sound on St. Simons Island, Glynn County, Georgia. Fort Frederica is managed by the National Park Service as a National Historic Monument, and the primary recreational uses of the fort site, consisting of 209 acres, are for historic appreciation and picnicking (Georgia Department of Natural Resources 1975a).

Visitation rates at Fort Frederica in recent years have ranged from a high of 242,000 visitors in 1967 to a low of 157,000 in 1971. Peak visitation at Fort Frederica occurs during the summer months, primarily during August (Georgia Department of Natural Resources 1975a).

Approximately 63% of the visitors to Fort Pulaski and Fort Frederica come from Georgia and South Carolina, 24% come from other southeastern States, and the remaining 13% come from other areas of the country or from foreign countries. During the summer months, 60% to 70% of the visitors are from outside of Georgia (Georgia Department of Natural Resources 1975a).

E. CUMBERLAND ISLAND NATIONAL SEASHORE

Cumberland Island National Seashore was established 23 October 1972 to preserve the scenic, scientific, and historical values of the largest and most southerly island off the coast of Georgia (U.S. Department of Interior, Fish and

Wildlife Service 1978). It is a low island with only an occasional dune reaching 50 ft (15.2 m) above sea level. A detailed physiographic description of the island is found in Volume 1, Appendix B.

In accordance with congressional legislation, the seashore will be permanently protected in its primitive state except for certain portions especially adaptable for recreational uses. No road or causeway from the mainland will be constructed.

The acquisition of land and the planning for future use of the seashore are underway. Approximately 85% of the island has been acquired; some longtime private owners have the option to retain rights for themselves and their heirs. The National Park Service, which administers the seashore, currently has a temporary headquarters in St. Marys. A permanent visitors' center and ferry docking facility are located on the mainland. A small visitors' center is located at Sea Camp on the island.

Camping facilities are available and overnight visitors may choose between a 16-site developed campground and three primitive back-country sites. Camping is limited to 7 days. The developed campground offers restrooms, showers, and drinking water. Campfires are permitted in the developed campground, but only fallen wood may be burned. There are no facilities in the back-country and campfires are not allowed. Back-country camping permits are required.

F. SAPELO ISLAND NATIONAL ESTUARINE SANCTUARY

In December 1976, 7,400 acres (2,995 ha) of Sapelo Island uplands and adjacent marsh were Federally designated the Sapelo Island National Estuarine Sanctuary. It was the second estuarine sanctuary in the Nation at that time (Georgia Department of Natural Resources, Coastal Resources Division n.d.).

Sapelo was chosen as an estuarine sanctuary because of its unspoiled condition and well-documented natural history. State ownership of the island assures protection from development. Additional buffers are provided by two Federal wildlife preserves: Blackbeard Island to the northeast and Wolf Island to the south.

The sanctuary acts as a control; it will be conserved in a pristine state to provide a standard by which the quality of air, water, and soil in developed coastal areas can be measured. The sanctuary program requires periodic monitoring of the Duplin River estuary to detect any changes in environmental quality.

Funds for the sanctuary program are provided by the U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Within this agency, the Office of Coastal Zone Management regulates the estuarine sanctuary program on a national scale, passing administrative responsibilities for individual sanctuaries to the appropriate State Coastal Zone Management agency. In Georgia, that agency is the Department of Natural Resources, Coastal Resources Division, which operates the Sanctuary in cooperation with Game and Fish Division personnel on Sapelo Island.

IV. NATIONAL FOREST

There is only one national forest within the Sea Island Coastal Region of South Carolina and Georgia. This is the Francis Marion National Forest, located in Berkeley and Charleston counties, South Carolina (Atlas plate 29). This forest contains 249,412 acres (100,937 ha) and is bounded by the Santee River on the north, the Intracoastal Waterway on the east, the Wando River on the south, and Lake Moultrie and the Cooper River on the west (U.S. Department of Agriculture, Forest Service 1977).

During 1975, a total of 193,700 visitor-days of recreational use was expended in the Francis Marion National Forest. Use at developed sites accounted for 26% of the total, while the remaining 74% was accounted for by dispersed recreational usage. The principal recreational activities were fishing, camping, picnicking, boating, swimming, and hunting (Table 9-10).

The annual increase in visitor use averaged 5.4% during the period from 1971 to 1975. The increase in family-oriented activities was above average, while the increase in single visitor use, such as hunting, was below average during this period (U.S. Department of Agriculture, Forest Service 1977). When construction to widen U.S. Highway 17 to four lanes is completed within the National Forest area, an increase in recreational traffic is anticipated.

There are 20 developed recreational sites within the Francis Marion National Forest (Table 9-11). Only one of these sites is currently exceeding 30% of its designed capacity (Buck Hall Picnic Ground), indicating that these recreational resources are underutilized at present. In addition to developed recreational sites, most of the remaining area of the National Forest is open for dispersed recreation.

Hampton Plantation, which lies within the boundaries of the National Forest,

Table 9-10. Principal recreational activities within the Francis Marion National Forest during 1975 (U.S. Department of Agriculture, Forest Service 1977).

ACTIVITY	PERCENT OF TOTAL RECREATION USE
Fishing	15.5
Camping	15.3
Picnicking	14.7
Boating and Swimming[a]	13.8
Hunting	13.2
Auto Driving	9.8
Hiking	4.1
Motorcycling	3.2
All other activities	10.4

a. Includes all other water-oriented activities.

has been nominated for inclusion on the National Register of Historic Places. A portion of Hampton Plantation (321 acres or 129.9 ha) was recently acquired by the State of South Carolina, and it is currently being developed as a State historical park.

During 1975, approximately 2,200 visitor-days were expended in the National Forest on nature study and wildlife observation (U.S. Department of Agriculture, Forest Service 1977). Several areas that were heavily utilized for these purposes include: Little Ocean Bay, Big Opening, Cedar Hill Island, Wambaw Creek, The Battery, and Watahan Plantation.

Little Ocean Bay (75 acres or 30.4 ha) is a typical Carolina Bay that is covered by 1 - 2 ft (0.3 - 0.6 m) of standing water during much of the year. The bay provides suitable cover for a variety of birds, snakes, turtles, and frogs. Recreational use of this area is currently limited.

Big Opening (470 acres or 190 ha) is a relatively open area inside Hell Hole Bay. In 1954, a fire in the area destroyed the trees and allowed the intrusion and growth of aquatic weeds and grass. This has attracted a great number of ducks and other waterfowl to the area.

Cedar Hill Island (770 acres or 311.6 ha) is bordered by the Santee River on the north and Chicken Creek on the south. During the early 1900's, the area contained cultivated rice fields. These rice fields are now abandoned and the area contains many large swamp hardwoods.

Wambaw Creek (820 acres or 331.9 ha) is a tidal blackwater creek running approximately 20 mi (32.2 km) from its headwaters in Wambaw Swamp to the Santee River. The creek winds through large cypress trees interspersed with younger cypress, gum, maple, and other bottomland hardwood species. The hardwoods that overhang the creek, broken by pine bluffs at Still Landing and Jack's Bluff, provide a highly scenic corridor. Wildlife, such as deer, river otter, alligator, and a vast assortment of birds, inhabit the area. The creek also offers good fishing and is a popular canoe and boating trail.

The Battery (60 acres or 24.3 ha) is an earthen Civil War fortification located on the bank of the Santee River. It was built in 1863 and manned by part of the 2nd Santee Light Artillery under the command of Captain Gailliard until 1865. Only one small skirmish was fought here. The fortification consists of an earthen wall about 20 ft (6.1 m) high and 300 ft (91.4 m) long with excavated areas along the wall for six gun emplacements. The Battery lay abandoned and unknown to all but local people until 1944.

Wataham Plantation is the site of one of the first plantations on the Santee River and was established by Daniel Huger prior to 1700. During the American Revolution, a battle between General Marion's troops and British troops was fought here in 1782. The buildings were

Table 9-11. Developed recreational sites within the Francis Marion National Forest (U.S. Department of Agriculture, Forest Service 1977).

Type of Site	Site Name	Capacity[a]	Percent of Use of Designed Capacity
Campground	Buck Hall	90	7.7
	Honey Hill	45	7.6
	Guilliard Lake	30	25.1
	Elmwood	20[b]	No Data
	Huger	10[b]	No Data
	Tar Pit	6[b]	No Data
Picnic ground	Buck Hall	35	78.4
	Huger	80	16.4
	Tar Pit	30	27.4
	Canal	15	29.2
Hunt camps	Elmwood	100	10.5
	Halfway Creek	60	2.1
	Awendaw	60	No Data
Swimming site	Canal	120	3.8
Rifle range	Boggy Head	6	22.8
	Twin Ponds	6	No Data
Boating site	Buck Hall	65	6.7
	Huger	70	1.6
	McConnell's Landing	No Data	No Data
	Still Landing	No Data	No Data
	Elmwood	No Data	No Data
	Laurel Hill	No Date	No Data

a. Persons at one time.
b. Number of campsites.

destroyed many years ago and only a few bricks from the chimney and foundation remain.

In addition to the aforementioned special interest areas, there are six classified areas within the Francis Marion National Forest, five of which are suitable for nature study and wildlife observation, while the sixth is an archaeological site that is on the National Register of Historic Places (Table 9-12). These areas are being managed to protect the values for which they are classified.

Off-road vehicle use in the National Forest occurs mainly on primitive systems roads and trails used in past logging operations. Cross country travel by off-road vehicle is limited by heavy undergrowth, and there are several areas that are closed to such usage. Most of the off-road vehicles using the National Forest employ four-wheel drive. Public trails closed to motor vehicles have a history of resource degradation due to vehicle use and are therefore not suitable for motorized vehicle use. It is anticipated that there will be continuing pressure for off-road vehicle use within the National Forest.

There are 85 mi (136.8 km) of trails within the National Forest that can be used for various recreational purposes. These are: Wambaw Cycle Trail (42 miles or 67.6 km), Jericho Horse Trail (29 miles or 46.7 km), and the Swamp Fox Hiking Trail (14 miles or 22.5 km).

The U.S. Department of Agriculture, Forest Service (1977) has estimated that by 1980, in order to meet increased recreational demands, four parks will be needed within the Francis Marion National Forest. One of these parks, Hampton Plantation, is currently being developed by the South Carolina Department of Parks, Recreation, and Tourism.

V. NATIONAL WILDLIFE REFUGES

The U.S. Fish and Wildlife Service operates more than 330 National Wildlife Refuges throughout the United States (U.S. Department of Interior, Fish and Wildlife Service 1973). Many of them provide nesting, feeding, and resting sites for waterfowl and other wildlife species.

Many refuges are developed and managed in ways to make them better places for wildlife and people. Large farming operations during the summer provide food for hungry waterfowl that come to spend the winter. These waterfowl contribute to visitors' enjoyment. Impoundments with structures to regulate water levels are managed to yield a maximum growth of aquatic food plants. Some farm fields are planted for the special benefit of deer, bobwhite, and other upland species. Woodlands are managed in such ways that both wildlife and timber are benefited, including the fall and winter flooding of trees to make mast available to waterfowl.

The public is encouraged to visit most National Wildlife Refuges to view and photograph the many types of wildlife and to observe management techniques in operation. When not inconsistent with the protection and management of wildlife, certain recreational uses may be enjoyed by the public. Many refuges offer excellent sport fishing in summer, and in some areas fishing camps are operated under

Table 9-12. Classified areas within the Francis Marion National Forest which provide nature study and wildlife and historical observation opportunties (U.S. Department of Agriculture, Forest Service 1977).

Kind of Area	Area Name	Acres (ha)
Scenic Area	Little Wambaw Swamp	1,025 (414.8)
	Guilliard Lake	925 (374.3)
Natural Area	Little Wambaw Swamp	60 (24.3)
	Guilliard Lake	18 (7.3)
Wilderness Study Area	Wambaw Swamp[a]	2,009 (813.0)
Archaeological Area	Sewee Indian Shell Mound	250 (101.2)

a. Includes Little Wambaw Swamp Scenic Area and Natural Area.

lease. Where waterfowl and upland game populations warrant it, refuges have managed gun and archery hunts. Picnic sites and facilities are found on some refuges.

There are nine National Wildlife Refuges located within the coastal regions of South Carolina and Georgia (Atlas plates 27 and 29). These refuges provide a variety of primary recreational uses (Table 9-13).

A. CAPE ROMAIN NATIONAL WILDLIFE REFUGE

The Cape Romain National Wildlife Refuge, containing 55,066 acres (22,285 ha) of tidal creeks, bays, barrier islands, and marshlands, stretches for 15 mi (24 km) along the South Carolina coast. Refuge habitat includes approximately 20,836 acres (8,432 ha) of open salt water and tidal creeks and 34,230 acres (13,853 ha) of fee title land in public ownership. The refuge-owned lands include 1,500 acres (607 ha) of forest land, 985 acres (397 ha) of freshwater impoundments, 85 acres (34 ha) of farmland or wildlife openings, nearly 20 mi (32.2 km) of sandy beaches and dunes totalling 1,700 acres (688 ha), and 29,960 acres (12,125 ha) of salt marsh (U.S. Department of Interior, Bureau of Outdoor Recreation 1970).

The refuge was created to preserve, in public ownership, habitat for waterfowl, shore birds, endangered species, and native game animals. Other objectives include the preservation of Bull Island's forest, with its diverse plant community, in an undisturbed condition; protection of the beaches of Bull and Cape islands for loggerhead turtle nesting; and preservation of the saltwater bays and marsh habitat for shellfish and other marine resources. The use of refuge lands for a unique outdoor recreational experience is one of the objectives of the National Wildlife System. To provide opportunities for the public to study, understand, appreciate and utilize the fish and wildlife resources is a goal of the Cape Romain Refuge.

Since most of the refuge is accessible only by boat, refuge usage is currently limited to local residents. In past years, refuge visitation has been relatively low because of the lack of public boat transportation. In 1961, approximately 5,000 people visited the refuge. By 1968, this number had increased to 10,000 (U.S. Department of Interior, Bureau of Outdoor Recreation 1970).

Principal recreational activities permitted within the refuge include wildlife observation, photography, nature study, fishing, hunting, camping, and picnicking. Viewing, photographing, and studying the refuge's wildlife and scenery are encouraged. Of the 10,000 visitors to the refuge in 1968, approximately 4,000 came to view wildlife. There are some 20 mi (32.2 km) of roads and trails on Bull Island which can be used for hiking and nature study activities.

The greatest visitor use of the refuge is by fishermen. Surf fishing along the beaches and freshwater fishing on the Jacks Creek Impoundment on Bull Island are extremely popular. Surf fishing is permitted during daylight hours throughout the year along those refuge islands not used heavily by nesting shore birds.

Public hunting has been permitted in the past on a portion of the refuge marsh for marsh hens and on Bull Island for white-tailed deer, turkeys, and squirrels. Hunting is permitted only when game populations warrant a harvest.

In the past, overnight camping has been permitted on Bull Island during the annual deer hunts and at other times for supervised groups interested in wildlife-related activities. There are picnic facilities located near the visitor contact station on the west side of Bull Island.

B. SANTEE NATIONAL WILDLIFE REFUGE

The Santee National Wildlife Refuge, located in Clarendon and Berkeley counties, South Carolina, was established on 31 July 1941. It is situated on and adjacent to Lake Marion, is comprised of approximately 43,000 acres (17,402 ha), and is managed specifically for wintering waterfowl. Corn is planted by refuge personnel and co-operative farmers on a share basis each year. The refuge's share is mainly left in the fields for the wintering birds.

C. PINCKNEY ISLAND NATIONAL WILDLIFE REFUGE

Pinckney Island National Wildlife Refuge is the newest refuge located in the coastal areas of South Carolina and Georgia. The refuge, located in Beaufort County, South Carolina, was willed to the Federal Government and brought into the National Wildlife Refuge System in December of 1975. The island and adjacent marshes total 4,052 acres (1,640 ha) (Island Packet Newspaper 1977).

A management plan is currently being preoared for the refuge, which is not officially opened to the public yet. Wildlife observation will be the primary public use objective, including nature walks, bird watching, and photography. Some controlled deer hunting may be allowed if the deer herd gets out of balance. Plans call for increasing the diversity of wildlife habitat with additional water acreage for migratory birds, wildlife plantings, and some acreage being put back into hardwoods.

Table 9-13. Characteristics of National Wildlife Refuges located within the Sea Island Coastal Region of South Carolina and Georgia.

	County	Acreage[a]	Primary Recreational Uses
South Carolina			
Cape Romain	Charleston	55,066	Wildlife observation, nature study, fishing, hunting, camping, picnicking, hiking
Santee	Berkeley and Clarendon	75,000	Waterfowl hunting, sport fishing, wildlife observation, nature study
Pinckney Island	Beaufort	4,052	Wildlife observation
Georgia			
Savannah	Chatham[b]	13,169	Waterfowl hunting, sport fishing, wildlife observation, nature study
Tybee	Chatham	100	Wildlife observation
Wassaw Island	Chatham	10,064	Fishing, hunting, swimming, primitive wildlife observation, camping
Harris Neck	McIntosh	2,687	Wildlife observation
Blackbeard Island	McIntosh	5,618	Fishing, hunting, camping, hiking, wildlife observation
Wolf Island	McIntosh	5,126	Wildlife observation, boat fishing

a. 1 acre = 0.4047 ha.
b. Part located in Jasper County, South Carolina.

D. SAVANNAH NATIONAL WILDLIFE REFUGE

Established in 1927, the Savannah National Wildlife Refuge is comprised of 26,555 acres (10,747 ha) of land, water, and marsh in Georgia and South Carolina. It serves as the headquarters for all of the National Wildlife Refuges in coastal Georgia (Wilbur Smith and Associates 1975).

The Savannah Refuge largely occupies an area that once contained numerous rice plantations. Over the years, the rice plantations disappeared, the area reverted to tidal marshes and pasture land, and the waterfowl habitat degenerated. However, careful re-establishment of the old rice field impoundments has restored the waterfowl habitat, and today numerous species of waterfowl, as well as white-tailed deer and American alligator, can be found on the Savannah Refuge.

Fishing and hunting (both regulated by seasonal permits), sightseeing, bird watching, nature study, and wildlife observations are the primary recreational activities available to visitors.

E. TYBEE ISLAND NATIONAL WILDLIFE REFUGE

Tybee Island National Wildlife Refuge is on Oysterbed Island at the mouth of the Savannah River (Wilbur Smith and Associates 1975). It consists of 400 - 500 acres (162 - 202 ha) and was established in 1938. It is administered by personnel from the Savannah National Wildlife Refuge.

The U.S. Army Corps of Engineers owns spoilage rights on Oysterbed Island and, as a result, much of the island is covered with dredged materials from the Corps' work in the Savannah River. In spite of this, numerous marsh, water, and shore birds use the tidal flats and beach areas of the island as resting and feeding places. Raccoons, marsh rabbits, and small rodents are the major mammals on the island.

F. WASSAW ISLAND NATIONAL WILDLIFE REFUGE

Wassaw Island National Wildlife Refuge is considered the best example of conditions that prevailed in coastal Georgia before the European settlements were established (Wilbur Smith and Associates 1975). This refuge is located immediately south of Tybee Island, and includes some 10,064 acres (4,073 ha). Bought by the Nature Conservancy from the Parsons Family Trust, the refuge was donated by the Conservancy in 1969 to the U.S. Fish and Wildlife Service for use as a refuge. A central tract of 180 acres (73 ha) is held in private ownership by the former owners.

Nearly 90% of this refuge is salt marsh and is part of the rich coastal estuarine ecosystem, one of Georgia's most important natural resources. Wildlife includes a thriving deer population, and endangered and threatened species such as American alligator, brown pelican, osprey, and loggerhead sea turtle. Generally, public use of this refuge is limited to the beach and some interior trails on a day-use basis only. However, controlled archery deer hunts are held several times each year, and primitive overnight camping is available by permit.

G. HARRIS NECK NATIONAL WILDLIFE REFUGE

Harris Neck National Wildlife Refuge was established in 1960 from lands formerly used as an auxillary military airfield (U.S. Department of Interior, Bureau of Outdoor Recreation 1973). The refuge is located 50 mi (80.5 km) south of Savannah at the end of State Route 131. Fronting on the South Newport River at the northern end of McIntosh County, the Harris Neck Refuge contains 2,687 acres (1,087 ha). It is open 5 days a week with limited visitation permitted, including special camping groups (Wilbur Smith and Associates 1975). A wide variety of birds and mammals inhabits the refuge, including Canada geese, wood ducks, snow and blue geese, raccoons, white-tailed deer, turkeys, fox squirrels, and opossums.

H. BLACKBEARD ISLAND NATIONAL WILDLIFE REFUGE

Blackbeard Island National Wildlife Refuge was established in 1880 and is one of the older units of the refuge system (Wilbur Smith and Associates 1975). It is also one of the more successful refuges, populated by numerous species of waterfowl and other birds, reptiles, and mammals. The refuge contains 5,618 acres (2,274 ha) with about 9 mi (14.5 km) of beach on the Atlantic Ocean.

Blackbeard is a very important refuge because many less common species of wildlife can be found there. Some of these include loggerhead sea turtles, American alligators, ospreys, and bald eagles. A large population of white-tailed deer also inhabits the island, and limited hunting of these animals is permitted at special times of the year.

Limited camping is permitted on the island. Access to the island is by boat only, and prior arrangements are required by the Fish and Wildlife Service to secure transportation access permission. In 1974, 5,000 acres (2,023 ha) of Blackbeard Island Refuge received protection under wilderness status.

I. WOLF ISLAND NATIONAL WILDLIFE REFUGE

Wolf Island National Wildlife Refuge was established in 1930 (Wilbur Smith and Associates 1975). The refuge, on the southern edge of McIntosh County fronting on the Atlantic Ocean just south of Sapelo Island, contains 5,126 acres (2,074 ha). It was recently designated as a wilderness area, which places very stringent restrictions on development, access, and public use. According to refuge personnel, no developments or improvements have been made on the island and none are planned in the future.

VI. STATE PARKS

There are 13 State parks located within the Sea Island Coastal Region of South Carolina and Georgia (Atlas plates 41, 42 and 43). Eight of these are in coastal South Carolina and five are in coastal Georgia. These parks are well distributed along the coast and offer a variety of recreational opportunities.

A. SOUTH CAROLINA

There are 40 State parks located in South Carolina. During the period 1966 through 1974, attendance at these State parks increased from 2.5 million to 9 million annually (South Carolina Budget and Control Board 1976). This increase in user-occasions has continued in more recent years. Eight of these parks are located within the Sea Island Coastal Region and offer a variety of recreational activities (Table 9-14). These coastal parks include Colleton, Charles Towne Landing, Edisto Beach, Givhans Ferry, Hampton Plantation, Hunting Island, Huntington Beach, and Old Dorchester. Three of these parks (Huntington Beach, Edisto Beach, and Hunting Island) are located on the ocean. A brief description of each of the eight Sea Island Coastal Region State parks located in South Carolina follows.

1. Colleton State Park

Colleton State Park is located near Canadays in Colleton and Charleston counties. A camping area, picnic shelters, picnicking area, and fishing in the Edisto River are available at this 35-acre (14 ha) park.

2. Charles Towne Landing

Charles Towne Landing is the site of South Carolina's first permanent settlement in 1670. This 667-acre (270 ha) State park includes picnic shelters, a seventeenth-century trading post replica, a restaurant, a 200-acre (81 ha) animal forest, nature and historical interpretive centers, a nature trail, open air exhibit pavilion, 400-seat theater, and parking for 1,000 cars (Hartzog, Lader and Richards, Inc. 1975). This park is located 3 mi (4.8 km) from downtown Charleston on South Carolina Highway 171, off Highway 61.

3. Edisto Beach State Park

Edisto Beach State Park is located 50 mi (80.5 km) southeast of Charleston on South Carolina Highway 174. Facilities include five cabins overlooking Scott Creek (22 additional cabins have been proposed), 75 tent and trailer camping sites, several group camping areas, an interpretive center, a bathhouse, an 18-hole miniature carpet golf course, a picnic area, two comfort stations, a playground, and day-use parking for 250 cars. The park has 2.25 mi (3.6 km) of sandy oceanfront beach 160 - 200 ft (48.8 - 61.0 m) wide, three-quarters of a mile of which is used for swimming. The park is open daily and is free of charge.

4. Givhans Ferry State Park

Givhans Ferry State Park is 1,235 acres (500 ha) in size and includes 25 campsites, 5 vacation cabins, picnic shelters, 3 rest stations, a community assembly building, and nature trails. Parking is available for 200 cars. Givhans Ferry is located 16 mi (25.7 km) west of Summerville on South Carolina Highway 61.

5. Hampton Plantation State Park

Historic restoration and preservation of the house and grounds of Archibald Rutledge, poet laureate of South Carolina, is the focus of Hampton Plantation State Park. Located near McClellanville on U.S. Highway 17, the park contains 322 acres (130 ha).

6. Hunting Island State Park

Hunting Island State Park, located 16 mi (25.7 km) east of Beaufort, South Carolina, on U.S. Highway 21, contains the following facilities: a 136 ft (41.5 m) lighthouse built in 1873, a wildlife observation area with nature trails, 200 campsites, four comfort stations, day-use parking for 400 cars, a bathhouse, 13 rental cabins, picnic and swimming areas, a boat-launching ramp, a small playground, and a carpet golf course. The park covers 5,000 acres (2,023.5 ha).

7. Huntington Beach State Park

Huntington Beach State Park is located approximately 17 mi (27.4 km) south of Myrtle Beach on U.S. Highway 17. Presently, recreation consists of swimming, fishing, camping, carpet golfing, and picnicking. A majority of the park's 2,500 acres (1,012 ha) is in tidal marsh. It contains an 18-hole carpet golf course, a concession stand, shelters, bathhouse and dressing rooms, a small playground, and parking space for an estimated 220 cars.

Table 9-14. Facilities and selected characteristics of State parks located in the Sea Island Coastal Region of South Carolina (Hartzog, Lader and Richards, Inc. 1975; South Carolina Department of Parks, Recreation and Tourism 1975a, 1976b).

PARK	Family Campsites (No.)	Vacation Cabins (No.)	Youth Camping	General Store	Assembly Building[a]	Picnic Area[b]	Swimming Area[c]	Food[d]	Trail[e]	Interpretive Center	Summer Programs	Carpet Golf	Bicycle Rentals	Fishing[f]	Rental Boats[g]	Acres[h]	Date Established
Colleton	25		X			S			N					R		35	-
Charles Towne Landing					R,C	S		R	N	X	X		X		X	667	1971
Edisto Beach	75	5	X			S	O	RS	N		X	X		O		1,255	1956
Givhans Ferry	25	4	X		C	S	R	RS	N					R		1,235	1934
Hampton Plantation					PARK UNDER DEVELOPMENT											322	1971
Hunting Island	200	11	X	X	R	S	O	RS	N,B	X	X	X		O	R	5,000	1938
Huntington Beach	128		X	X	R	S	O	RS	N,B	X	X	X		O		2,500	1960
Old Dorchester						X				X				R		97	1960

a. R - Recreation, C - Community

b. S - Shelter

c. O - Ocean, R - River

d. R - Restaurant, RS - Refreshment Stand

e. N - Nature, B - Boardwalk

f. O - Ocean, R - River

g. R - Ramp

h. 1 acre = .4047 ha

i. x - available

The park has 2.93 mi (47 km) of ocean frontage, with a 140-ft (42.7 m) wide beach at low tide. The park has 127 campsites (a 52-unit and a 75-unit area) for tent and trailer usage, with utility hookups, tables, and grills at each site. There are two comfort stations with restrooms and showers. A trading post, recreation building, and small playground are located in the 75-unit camping area. The 52-unit camping area has no recreational facilities immediately available.

8. Old Dorchester State Park

Old Dorchester State Park is located 6 mi (9.6 km) south of Summerville on S.C. Highway 642, approximately 20 mi (32.2 km) from Charleston, and includes a picnic and fishing area and 100 parking spaces. The 97.4-acre (39 ha) park is part of the ruins of a 1788 community.

B. GEORGIA

The five State parks in the coastal area of Georgia are Crooked River, Richmond Hill, Santa Maria, Skidaway Island, and Jekyll Island. (See Atlas plates 41 and 42 for locations of Georgia State parks.) Table 9-15 presents data on facility availability at these five parks. Blythe Island (Glynn County) is a new State park being planned by the Department of Natural Resources.

1. Crooked River State Park

Crooked River State Park is located on the eastern edge of the mainland of Camden County at the mouth of the Satilla River. It is especially popular with fishing and boating enthusiasts, and provides one of the few points of public access to estuarine waters in Camden County. With Cumberland Island National Seashore open to the public, the camping and picnicking facilities at Crooked River State Park are expected to be in great demand. Because of its proximity to Cumberland Island, it was one of several alternative locations considered as sites for visitor departure to Cumberland Island. The number of visitors to Crooked River State Park has increased from 119,908 in 1966 to 178,990 in 1974 (Table 9-16).

2. Richmond Hill State Park

Richmond Hill State Park, in Bryan County, opened late in fiscal year 1972 and recorded its first full year of use in fiscal year 1973. Both Richmond Hill and Skidaway Island State Parks provide camping and recreational facilities close to metropolitan Savannah. A total of 116,503 visitors was reported at Richmond Hill State Park in 1973; however, visitation dropped to 67,788 in 1974 (Table 9-16).

3. Santa Maria State Park

Santa Maria State Park, in Camden County, is a day-use park with picnic tables and historic tabby ruins of sugar houses. No visitor statistics are recorded for this park.

4. Skidaway Island State Park

Skidaway Island State Park, located on the western shore of Skidaway Island in Chatham County, is a recent addition to the State park system. The park includes camping and picnicking facilities, a visitors' center, and a swimming pool. No visitor statistics are recorded for this park.

5. Jekyll Island State Park

The State of Georgia purchased Jekyll Island, located in Glynn County, in September 1947 for use as a State park. It is now known as Jekyll Island State Park and is operated by the Jekyll Island State Park Authority. Extensive development of the island has taken place since it was acquired by the State. About 6 mi (9.7 km) of access road and a bridge were constructed in 1954, at a cost of about $5 million, linking the island with U.S. Highway 17. A 3,900-ft (1,189 m) airstrip has been constructed for private planes (U.S. Congress 1976).

The island is served with a complete water and sewer system, a fire department, shopping center, postal and police service, and other conveniences. An energetic management continues to expand the development with the active support of the State. It is estimated that the State of Georgia has invested $25 million and that private interests have invested another $30 million in the development of Jekyll Island. According to the Jekyll Island State Park Authority, the estimated monies spent by visitors to Jekyll Island amount to about $40 million annually (U.S. Congress 1976).

Jekyll Island's popularity as a resort area is attributable primarily to extensive, high-quality development and the compatibility of that development with the island's abundant natural resources. Management, operation, and maintenance of park facilities; favorable climate; abundant surface-water resources; and major highway, waterway, and air transportation services are also contributing factors. Unlike many heavily commercialized resort areas to the south, Jekyll Island enjoys a substantial annual repeat-visitation, attracting visitors from all parts of the Nation. During the early spring season, from 75% to 90% of total visitation is reportedly attributable to Canadians, and visitation is frequently recorded for

Table 9-15. Facilities and selected characteristics of State and Federal parks in the Sea Island Coastal Region of Georgia (Georgia Department of Natural Resources 1975a, 1977a, U.S. Congress 1976).

PARK	Cottages (No.)	Campsites (No.)	Dump Station	Swimming Pool	Concessions	Picnic Area	Boat Ramp	Fishing	Fishing Pier	Nature Trail	Pioneer Camping Area	Miniature Golf	Boat Rentals	Boat Dock	Visitor Center	Historical Sites	Tennis Courts	Convention Facilities	Ball Fields	Golf Courses	Motels	County	Acreage[a]
State Parks																							
Skidaway Island		100	X	X	X	X									X							Chatham	480
Richmond Hill		30	X			X	X	X					X	X								Bryan	190
Crooked River	11	100	X	X	X	X	X	X	X	X	X	X										Camden	500
Santa Maria						X										X						Camden	66
Jekyll Island	X	300		X	X	X		X	X	X		X		X	X	X	X	X	X	X	X	Glynn	13,500
Federal Parks																							
Cumberland Island National Seashore		19				X		X		X	X					X						Camden	42,000

a. 1 acre = 0.4047 ha

Table 9-16. Annual user-occasions at three State parks in the coastal area of Georgia, 1966 - 1974 (Georgia Department of Natural Resources 1975a, U.S. Congress 1976).

YEAR	JEKYLL ISLAND	CROOKED RIVER	RICHMOND HILL
1966	2,121,008	119,908	
1967	2,226,951	120,819	
1968	2,498,853	113,319	
1969	2,764,864	77,534	
1970	2,703,181	81,955	
1971	2,829,959	136,003	
1972	2,970,612	207,695	79,503
1973	2,631,309	200,497	116,503
1974	2,744,000	178,990	67,788

citizens of many European and Latin American countries, as well as for citizens of Australia and New Zealand during all seasons of the year (U.S. Congress 1976).

Periods of peak visitation, of course, occur during summer months when local residents within a 100-mi (161 km) primary zone of influence are attracted to the beach on weekends. That day-use visitation is significantly supplemented by vacation use is attributable principally to residents of other parts of Georgia, the secondary zone of influence. The tertiary zone, comprising the remainder of the United States, also contributes substantial numbers. Based on special surveys conducted during the week of 16 August 1970, and subsequent spot checks by Savannah District and Jekyll Island State Park Authority personnel, summer visitation is distributed by State or area of origin as follows: Georgia (66%), Florida (10%), Tennessee (7%), Virginia (4%), Alabama (3%), North Carolina (3%), South Carolina (2%), Northeastern United States (3%), remainder of United States (1%), other (1%) (U.S. Congress 1976). This was a limited survey made near the end of the summer and therefore does not reflect the heavy spring influx of Canadian visitors.

VII. STATE WILDLIFE REFUGES AND GAME MANAGEMENT AREAS

State wildlife refuges and game management areas are used to provide habitat for wildlife and to provide wildlife-oriented recreation under closely controlled conditions. The main objective of State wildlife refuge systems is to provide protected habitat for wildlife. Most areas within this system also permit outdoor recreational activities which are compatible with this objective. Much of the land is under private ownership, and the owners provide access for the public. The main purpose of State wildlife management areas is to provide land for public hunting. Only hunters are required to pay use fees through the purchase of a Game Management Area Permit. Nonhunters may enjoy these lands at no charge, provided they observe the game management area regulations and use caution during the scheduled hunting season. The many campgrounds and scenic spots offer year-round recreation and relaxation.

A. SOUTH CAROLINA

Game management practices, including reintroduction of game species, habitat improvement, and regulated annual harvests, are carried out on the State management areas by biologists from the South Carolina Wildlife and Marine Resources Department. This ensures the welfare of many nongame species as well as that of game birds and mammals. The program's ultimate goal is to provide the highest quality recreational opportunities obtainable on these lands.

Within the coastal area of South Carolina, there are three State wildlife refuges: Santee Coastal Reserve, Tom

Yawkey Wildlife Center, and Capers Island. Including the Santee Coastal Reserve, there are 15 game management areas in the coastal area of South Carolina. In the 15 game management areas, there are a total of 327,999 acres (132,741 ha) (Table 9-17), or 26.5% of the total State game management acreage. See Atlas plate 29 for locations of these State wildlife refuges and game management areas.

1. Santee Coastal Reserve

During 1974, South Carolina acquired the Santee Coastal Reserve through the Nature Conservancy. A large portion of the reserve is suitable for traditional nature-related outdoor recreational activities as well as wilderness aesthetics.

The Santee Coastal Reserve consists of a mainland portion plus Cedar and Murphy islands. The mainland area covers approximately 7,500 acres (3,035 ha) and is made up of 5,200 acres (2,104 ha) of relatively open pine woods that are interspersed with 14 Carolina Bays and about 1,000 acres (405 ha) of impoundments. The Washo Reserve, leased from the Nature Conservancy by the South Carolina Wildlife and Marine Resources Department, is also located here. The Washo Reserve is a man-made, 200-year-old cypress-tupelo community that is one of the more important bird rookeries in the country. The Santee beach property offers an almost ideal situation for observing shore birds in their natural habitat. In addition to shore birds, numerous marsh birds, wading birds, pelagic birds, and other coastal birds may be observed here (South Carolina Wildlife and Marine Resources Department 1975a).

Cedar and Murphy islands are located about 1.5 to 4 mi (2.4 to 6.4 km) seaward of the mainland and are separated from it by vast expanses of wetlands and the

Table 9-17. State game management areas and their acreages within the coastal region of South Carolina (South Carolina Wildlife and Marine Resources Department 1978).

NAME	ACRES[a]
Wambaw[b]	
Northhampton[b]	249,401
Santee[b]	
Waterhorn[b]	
Hellhole[b]	
Moultrie	9,750
Hartley	1,200
Webb Wildlife Center and Palachucola	17,986
Cypress Creek	5,980
Bear Island	7,500
Turtle Island	1,700
Santee Delta	1,501
Samworth	1,275
Santee Coastal Reserve	25,000
Wildhorse	6,706
TOTAL	327,999

a. 1 acre = 0.4047 ha

b. Located in Francis Marion National Forest.

Atlantic Intracoastal Waterway (AIWW). Both islands are characterized by an open sandy beach zone facing the Atlantic Ocean to the east; low, heavily wooded high land areas consisting of former dune ridges containing maritime forests separated by low areas of marshlands, ponds, swamps, and tidal creeks; and extensive wetlands (mostly impounded) to the west. The estuarine waters adjacent to the islands include the North and South Santee rivers and Alligator Creek. Both islands are in a comparatively wild condition, although both areas have been inhabited, cultivated extensively, and managed for wildlife in past years.

The following discussion is based upon a management and recreational plan developed by the South Carolina Wildlife and Marine Resources Department (1975a) for the Santee Coastal Reserve.

The recreational activities proposed for the reserve can be classified into nine general groups. These include nature enjoyment and observations, sportfishing, boating and canoeing, shellfish gathering, hiking, camping, beach activities, historical site visits, and hunting.

The reserve provides excellent opportunities for nature enjoyment and for observing a wide array of wildlife. To assist these activities, five wildlife observation blinds with small walkways leading to them are planned, along with two observation towers. To date, four of the wildlife observation blinds have been constructed, one with an 800-ft (244 m) scenic boardwalk.

The reserve has considerable potential for increasing the recreational fishing opportunities available, including surf and shore fishing, small boat fishing, and possibly limited freshwater fishing.

General pleasure boating opportunities are not extensive and such activities will only be encouraged to a limited extent. The Intracoastal Waterway, Alligator Creek and Ormond Hall Creek all have possibilities for canoe trails, as do the large impoundments adjacent to the high land.

In regard to shellfish gathering, the South Santee River and Alligator Creek are productive areas for crabbing. Good oyster and clamming opportunities exist in Alligator Creek, a State-managed shellfish ground, and in the shallow area south of Grace Island. The South Santee provides recreational shrimping opportunities in the Alligator Creek area and on the South Santee shore of Murphy Island.

Four types of hiking trails, covering about 18 mi (29 km) are planned: a beach trail on Murphy Island, a marsh trail along the high land impoundments, a high land trail through the pine woods and Carolina Bays, and an interpretive trail near the Washo area. Each of these trails will provide the visitor with an opportunity to experience a different coastal environment and to view different wildlife species.

Three camping areas, consisting of several tent sites each, are planned. Wilderness camp sites will be located on the mainland near the Intracoastal Waterway and on Murphy Island. An additional primitive camp site and a small picnic area will be available on Cedar Island.

The opportunity for beach-type recreation is almost limitless at the Santee Coastal Reserve, with over 10 mi (16.1 km) of oceanfront beach. Activities may include surfing, swimming, sun bathing, beachcombing, and camping.

Several historically significant sites exist on the Reserve, including the remnants of several houses, slave quarters, storage buildings, a graveyard, a rice mill, and a hurricane tower. Efforts will be made to maintain preservation of old structures and trails to the sites, and interpretive signs will be provided to create outdoor museums for visitors.

Restricted public deer hunting is available, but only at a level necessary to manage the deer population. Gun and archery hunts are held. In addition, public waterfowl and marsh hen hunting are permitted in the waters and open marsh surrounding the property.

The reserve was opened for public usage during March of 1975. Through June 30, 1975 some 400 man-use days were expended on recreational activities, including hiking, bird-watching, camping, fishing, nature study, and aesthetic enjoyment (South Carolina Wildlife and Marine Resources Department 1975a). During the 1976 fiscal year, the number of visitors increased to approximately 5,000 (South Carolina Wildlife and Marine Resources Department 1976).

2. Tom Yawkey Wildlife Center

The second State wildlife refuge within the coastal area is the Tom Yawkey Wildlife Center. This area, consisting of 17,845 acres (7,222 ha) of high land and marsh on North, South, and Cat islands, was bequeathed to the South Carolina Wildlife and Marine Resources Department in 1975 with the following stipulations for its use: North Island is designated as a wilderness area without any permanent structures, human habitation, or roads of any sort other than those necessary for the protection and management of the property; and access to this island is to be for scientific and educational purposes only (South Carolina Wildlife and Marine Resources Department 1975b).

A portion of South Island constitutes a waterfowl protection and feeding area in which no shooting or hunting is permitted. Access to the area is limited to that necessary for its maintenance and for scientific and research purposes, but not for general recreational activities. The remainder of the property is designated as a wildlife refuge area for migratory waterfowl and other birds.

3. Capers Island

Capers Island is a 2,000-acre (809 ha) barrier island purchased by the State of South Carolina during 1975 with funds received through the Bureau of Outdoor Recreation. Capers Island is protected by the South Carolina Heritage Trust Program and is managed by the South Carolina Wildlife and Marine Resources Department. The island is open to the public, although accessible only by boat. Boats can either be anchored in inlets along the beach or temporarily tied up at one of two recently constructed docks.

Although South Carolina maintains four beachfront State parks, Capers is the only primitive beachfront camping area in the State. There are no facilities of any kind and camping is by permit only. The front beach, littered with fallen trees due to active erosion, is an excellent location for surf fishing. The relative inaccessibility of the island also makes it a productive spot for gathering shells and driftwood. Due to the undeveloped condition of the island, there are ample resources for general nature studies (Laurie 1978a). (For a more detailed description of the physiography of Capers Island, see Volume I.)

Capers Island is an important addition to the lands now in public trust, including the adjoining Cape Romain Wildlife Refuge, Santee Coastal Reserve, and the Tom Yawkey Wildlife Center to the north. The island also serves as an important buffer zone between the refuge and the Isle of Palms, where private residential resort development is expected to be almost total in the near future.

B. GEORGIA

Within the coastal region of Georgia there are two State wildlife refuges (R. J. Reynolds State Wildlife Refuge and Lewis Island Natural Area) and four game management areas (two areas collectively designated the Brunswick Pulp and Paper Company Public Hunting Area, plus the Altamaha Waterfowl Management Area and the Hazzards Neck Wildlife Management Area). A brief description of these refuges and management areas follows. (See Atlas plate 27.)

1. R. J. Reynolds State Wildlife Refuge

The R. J. Reynolds State Wildlife Refuge is located on Sapelo Island, north of the mouth of the Altamaha River, and occupies 18,000 acres (7,284 ha) (Georgia Department of Natural Resources 1975a). Limited hunting is allowed at R. J. Reynolds. Primitive camping facilities are available, but transportation to the area is through personal arrangements only (Wilbur Smith and Associates 1975).

2. Lewis Island Natural Area

Composed mainly of 5,500 acres (2,226 ha) of gum and cypress trees, the Lewis Island Natural Area is an acquisition of the Georgia Heritage Trust Program and is managed by the Georgia Department of Natural Resources. Located on the Altamaha River 5 mi (8.0 km) upstream from Darien, the island is 8 mi (12.9 km) long and 2 mi (3.2 km) wide at its widest point. The island contains the State's only known stand of virgin cypress, which is believed to be over 1,300 years old.

3. Brunswick Pulp and Paper Company Public Hunting Area

There are two State wildlife management areas in Glynn County, leased from the Brunswick Pulp and Paper Company by the Department of Natural Resources. The northernmost unit is located along the Altamaha River across from the Lewis Island Natural Area and is part of a larger area that extends into neighboring counties. The southernmost unit is located on the western edge of Glynn County along State Route 32 and the Seaboard Coast Line Railroad. Both areas are good game preserves, and limited hunting is allowed. Overnight camping is not permitted. This public hunting area covers 60,000 acres (24,282 ha).

4. Altamaha State Waterfowl Management Area

The Altamaha State Waterfowl Management Area, on the Altamaha River south of Darien, extends approximately 12 mi (19.3 km) between the Lewis Island Natural Area and the Wolf Island National Wildlife Refuge. It is comprised of numerous small islands, some of which were rice plantations during the early to mid-nineteenth century, and covers 19,000 acres (7,689 ha). Regulated hunting of deer, waterfowl, and small game is permitted in certain portions of the area.

5. Hazzards Neck Wildlife Management Area

The 12,000 acre (4,856 ha) Hazzards Neck Wildlife Management Area is located on the north side of the Satilla River in Camden County. It is leased from the Brunswick Pulp and Paper Company, and is managed by the Georgia Department of Natural Resources. The same hunting regulations apply to this tract as to the two tracts in the Brunswick Pulp and Paper Company Public Hunting Area.

VIII. BEACHES AND PUBLIC ACCESS

To the casual observer, the United States seems to offer ample beach areas for everyone's recreation: 210 million Americans share 84,240 mi (135,572 km) of shore. But more than half of this coast is in Alaska, and, of the remainder, there are only 12,150 mi (19,554 km) of beaches (Hartzog, Lader and Richards, Inc. 1975). Only 65% of this total national shore is in the public domain, much of it reserved for military use, and only 4% of this coastline is suitable and available for public recreation. One-third of this amount is National Park Service or National Seashore frontage.

A. SOUTH CAROLINA

South Carolina's 181-mi (291 km) Atlantic shoreline includes 156 mi (251 km) of some of the nation's finer beaches. The Grand Strand area, from the State's northern boundary to Winyah Bay includes: North Myrtle Beach, Atlantic Beach, Myrtle Beach, Surfside Beach, Garden City Beach, Huntington Beach, North Litchfield Beach, Litchfield Beach and Pawleys Island. (Although outside the Sea Island Coastal Region, the Grand Strand area is included because of its impact on recreational resources.) Charleston County beaches are located on Bull Island, Isle of Palms, Sullivans Island, Folly Island, and Kiawah Island. Hunting Island and Daufuskie Island comprise Beaufort County's beach area. In addition, there are several tracts and reservations along the shoreline which have potential for recreational use. (See Atlas plates 9 - 14 for locations of South Carolina beachfront.)

It is significant that the State has made tremendous progress in protecting large portions of its coastal lands and beaches. An estimated 25% of South Carolina's coastline is now held in public trust by State or Federal government agencies. A relatively small portion of additional shoreline acreage is ensured of permanent environmental protection through land use deeds and restrictions in private residential developments.

South Carolina has a diversity of beaches and recreational facilities in the different regions of its coast, providing a variety of vacation and recreational experiences to meet the varied needs and tastes of residents and visitors. This diversity is the result of differences in the physical makeup of the beaches, marshes, and other land and water resources along the coast, as well as the varied land use decisions that have been made by private landowners, developers, business interests, and public agencies within each area of the coast.

Along the 60-mi (96.6 km) Grand Strand, developers of motels and other businesses have built thousands of oceanfront accommodations and other facilities. The Grand Strand municipalities have expended great effort to provide hundreds of public access points for people to enjoy the beaches.

The central area of the coast, which embraces lower Georgetown County, contains major estuaries, marshes, and coastal island beaches where accessibility is more difficult than along the Grand Strand. Land use decisions for the beaches and adjacent coastal lands and waters have stressed conservation-preservation actions and the acquisition of large tracts by Federal and State governmental agencies.

The lower coast, embracing the coastal island beaches of Charleston, Colleton, and Beaufort counties, offers still a different type of beach terrain and unique opportunities for leisure experiences. Exclusive resort and residential communities are the outstanding feature of private developments at Hilton Head Island and other sea islands of the lower coast.

Private enterprise, represented by beach landowners, developers, and businesses, has provided most of the capital and other resources to provide facilities that have attracted vacationers in ever-increasing numbers to South Carolina's coastal regions. Public agencies at both local and State levels have also provided facilities, promotion dollars, and public services while establishing an atmosphere conducive to the development of tourism as a major economic force in the beach and coastal areas.

Within the coastal area of South Carolina, there are 35 islands which have oceanfront beaches. Certain parameters related to the areal dimensions of the beaches of these islands are presented in Table 9-18. Based on these dimensions and an optimal recreational density of 200 ft^2 (18.6 m^2) per person for South Carolina beaches, an estimated recreational carrying capacity for developed and undeveloped beach areas has been calculated (Table 9-18). The total recreational carrying capacity of the developed areas is 238,673 persons/day while that of the undeveloped areas is 119,497 persons/day.

Beach demand from both day visitors and vacationers will continue to increase in the foreseeable future. Total day-use demand for South Carolina beaches was conservatively estimated to be 5.6 million beach-user occasions in 1975. This figure is expected to grow to 5.9 million occasions in 1980, 7.2 million occasions in

Table 9-18. Recreational carrying capacity of developed and undeveloped South Carolina ocean beaches (Hartzog, Lader and Richards, Inc. 1975).

DEVELOPED BEACH AREA	ESTIMATED BEACH ACREAGE (Acres)[a]	RECREATIONAL CARRYING CAPACITY (Persons/day)
North Myrtle Beach	163.5	35,600
Atlantic Beach	5.3	1,148
Myrtle Beach	171.2	37,303
Myrtle Beach State Park	16.7	3,643
Surfside Beach	26.9	5,860
Garden City Beach	48.5	10,560
Huntington Beach State Park	35.5	7,524
North Litchfield Beach	22.7	4,950
Litchfield Beach	27.3	5,940
Pawleys Island	30.3	6,600
Bull Island	76.0	16,552
Isle of Palms	72.7	15,840
Sullivans Island	43.5	9,472
Folly Island	58.6	12,767
Seabrook Island	10.9	2,376
Edisto Island	34.8	7,590
Edisto Beach State Park	20.9	4,554
Hunting Island State Park	43.8	9,530
Fripp Island	34.8	7,590
Hilton Head Island	276.4	60,192
TOTAL	1,220.3	238,673
UNDEVELOPED BEACH AREA		
Waities Island	28.7	6,254
Debidue Beach	40.0	8,712
North Island	96.7	21,120
South Island	13.3	2,904
Cedar Island	18.2	3,960
Murphy Island	30.5	6,653
Capers Island	10.9	2,376
Dewees Island	21.8	4,752
Isle of Palms (Eastern tip)	40.0	8,712
Kiawah Island	194.0	42,240
Pritchards Island	25.8	5,610
St. Phillips Island	10.3	2,244
Daufuskie Island	18.2	3,960
Turtle Island	-	-
TOTAL	351.5	119,497

a. 1 acre = 0.4047 ha

1985, and 8.1 million occasions in 1990 (Hartzog, Lader and Richards, Inc. 1975).

Although demand distribution may be effectively altered by provision or expansion of additional beach access points and recreation facilities, the total potential demand will probably not be diminished, and the origin of the demand is not expected to change significantly.

Day visitor access is a problem for the entire coast, but is particularly critical in the Charleston area. More than 45% of the State's beach-user occasions are generated by residents of the Charleston Standard Metropolitan Statistical Area. Parking is, perhaps, the most critical factor affecting day visitor opportunities, and legal parking (inadequate throughout the coast) is totally inadequate near Charleston. For example, capacity analysis identifies conservatively a need for three times as many legal parking spaces as are currently available at Sullivan's Island and twice as many at the Isle of Palms and Folly Island to merely accommodate the 1975 level of demand.

Total vacationer demand for beach use is estimated to be 15.4 million user-occasions in 1975, 16.3 million occasions in 1980, 17.3 million in 1985, and 18.3 million in 1990. Nonresident demand, current and projected, is more than five times as great as resident demand, indicating that South Carolina's coast is an important regional resource. Expansion of the vacation market is projected to occur at the greatest rate from 1980 to 1985 (Hartzog, Lader and Richard, Inc. 1975).

A major problem is the limit of available coastal recreation facilities for resident day users. Ever-increasing tourism and inadequate public parking facilities compound the constraints of the recreational carrying capacities of most beaches. Even the 1975 average summer weekend crowds strained the capacities of Myrtle, Sullivans, Folly, and Edisto beaches. Beach communities near large urban areas, principally Charleston, are threatened with traffic congestion and inordinate fiscal burdens because they will increasingly serve as metropolitan ocean playgrounds.

B. GEORGIA

Georgia's beaches, barrier islands, and salt marshes offer peaceful beauty, as well as recreational opportunities, to the tourist or resident. Although several beaches receive heavy recreational use, most islands and marshlands are not intensively used for recreation, due to private ownership and restricted access (Georgia Department of Natural Resources 1975a).

St. Simons Island and Sea Island reflect the demand for recreational beaches. Although there are no specific beach use figures, vehicle counts (adjusted to exclude residents who purchase passes) are indicators of the interest in beach areas and related facilities. Several nationally known resorts are located on St. Simons Island and Sea Island. In addition, there are several local public parks and numerous additional points of beach access at road endings. Visitor use (as reflected in vehicle counts, Table 9-19) is lowest in January and February, rises markedly

Table 9-19. St. Simons Island vehicle count, 1969 - 1974[a] (Georgia Department of Natural Resources 1975a).

	1969	1970	1971	1972	1973	1974
JANUARY	109,000	116,000	120,000	133,000	140,000	140,000
FEBRUARY	106,000	113,000	118,000	129,000	131,000	125,000
MARCH	127,000	134,000	141,000	160,000	161,000	152,000
APRIL	130,000	135,000	145,000	156,000	162,000	155,000
MAY	131,000	141,000	147,000	157,000	174,000	165,000
JUNE	135,000	144,000	155,000	169,000	174,000	164,000
JULY	143,000	150,000	160,000	174,000	180,000	177,000
AUGUST	141,000	147,000	156,000	173,000	175,000	174,000
SEPTEMBER	122,000	130,000	140,000	155,000	152,000	144,000
OCTOBER	128,000	138,000	145,000	153,000	161,000	149,000
NOVEMBER	120,000	125,000	135,000	140,000	145,000	137,000
DECEMBER	124,000	128,000	142,000	143,000	138,000	135,000
TOTAL	1,516,000	1,601,000	1,704,000	1,842,000	1,893,000	1,817,000

a. These statistics include resident as well as visitor traffic. Fluctuations are most likely due to recreational visits.

in March, and reaches a peak in July. This pattern of fluctuation has repeatedly occurred during the past 5 years, thus indicating almost year-round use. In addition to reflecting interest in recreational beaches, these figures also reflect the growing permanent population of the island.

The use of Jekyll Island has also steadily increased. The demand for resort and motel accommodations on the island is related to the demand for beaches and interest in historical and recreational attractions.

One of the greatest problems in determining demand for beaches is defining the type of experience desired. For some persons, an intensively used beach with many visitor services is attractive. For persons desiring a wilderness experience, even the presence of one other person may be disruptive. The U.S. Army Corps of Engineers states that the 15,000 ft (4,575 m) of shoreline suitable for public use on Tybee Island can serve 12,800 bathers. (Two persons per 75 ft^2 (6.9 m^2) of bathing space is the standard used.) Given the peak day figures of 25,000 bathers, it is understandable why there is a need for improving the Tybee Island beach. In a study of Cumberland Island carrying capacity, on the other hand, 4,000 persons along 1 mi (1.6 km) of beach was considered optimum at any one time (with a turnover rate of two times per day) in an intensive beach-use area. The concept of beach use at Cumberland Island National Seashore, even in intensive use areas, is relatively low-density when compared with Tybee Island, an urban beach.

C. PUBLIC ACCESS

An essential consideration in the ability of beaches to provide recreational activities is that of public access. The question of beach access has developed into a controversial social, political, and legal issue in recent years in America. While by no means a new problem, it has been in the last decade that the demand for beach recreation and the supply of beach areas available for public recreation have reached such an imbalance as to create crises situations in many communities. Private property rights, along with an increased sensitivity to the fragile nature of the coastal environment, have led to an ever-dwindling beach area that is freely available for public use.

Private ownership of beach areas is not the only cause of the beach access problem. Much of the beach area that is in public ownership is not available for public recreation because some of this land is put to use for government purposes that are incompatible with recreational use, such as military installations. An equally serious problem is the exclusionary nature of many locally owned beaches.

To solve the problems of beach access, public awareness, on the part of public officials and citizens, is needed. Questions that must be answered include the following: a) what are the nature and extent of public rights in both the foreshore and dry-sand areas, and b) how can public access to beaches be provided in light of private ownership of the uplands and foreshore areas? There is need for collective decisions by private interests and government (local, State, and Federal levels) to influence land use determinations. In the case of public beach facilities, acquisition by purchase, condemnation, or easement may be the most direct approach to expansion.

IX. CAMPING

Camping is a popular form of outdoor recreation in South Carolina, which has approximately 19,000 individual campsites statewide (South Carolina Department of Parks, Recreation, and Tourism 1976c). More than half of these campsites are found in the Myrtle Beach-Grand Strand area, called the "Camping Capital of the World," located immediately north of the Sea Island Coastal Region. There are two major types of campgrounds, publicly and privately owned. Within the coastal region of South Carolina, there are six State park campgrounds, six Federal campgrounds, and numerous privately owned campgrounds. See Tables 9-11 and 9-14 for locations and available facilities at State and Federal campgrounds in the Sea Island Coastal Region (Atlas plates 27 and 29).

In the coastal areas of Georgia, there are more than 1,100 recreational vehicle camp sites available, with potential for more than 350 additional sites on existing developments (Wilbur Smith and Associates 1975). In addition, there are about 125 camp sites specifically for tents; however, tents also can be used at most recreation vehicle camp sites as well. In terms of services available at these sites, 96% have water hookups, 95% have electricity, and 39% have sewer hookups (the primary reason for the smaller percentage of sewer services is the expense involved in installing such facilities). Most campgrounds have additional facilities such as pools, showers, restrooms and recreational areas. Some offer boat docks, general stores, and laundries.

Approximately five campgrounds are located on or near Interstate 95 or U.S. Highway 17 in coastal Georgia. However, they tend to be somewhat removed from most of the primary tourist attractions in the coastal area. The campgrounds on Jekyll Island are in excellent proximity to area tourist attractions, illustrating what can be done in a campground location to enhance the tourism potential of the coast. See Table 9-15 for park locations and available facilities at State and Federal campgrounds in Georgia's coastal area.

X. BOATING

Boating is one of the more popular recreational activities within the South Atlantic region (Cape Hatteras to south Florida) (U.S. Department of the Interior, Bureau of Land Management 1977a). It is an activity which has had considerable growth in recent years within the coastal counties of South Carolina and Georgia. Within the coastal counties of South Carolina, the number of registered boats increased 29.8% during the 1973 - 1977 period (Table 9-20). Georgia has only recently begun itemizing the number of registered boats by counties, and statistics are not presently available.

Pleasure boating is, in many cases, intimately involved with sport fishing for a majority of boat users. In a nationwide survey by the U.S. Coast Guard during 1974, it was shown that 72.8% of boating households used their boats most frequently for fishing, followed by cruising/sailing (62.8%), and water-skiing (30.1%) (Wulfsberg and Lang 1974).

Bromberg (1973) estimated that approximately 490,000 fishing trips were made during 1973 in the open ocean off Georgia and South Carolina, and that 740,000 fishing trips were made in the saltwater portions of rivers, sounds and bays of these States (Table 9-21). The economic impact of this segment of recreational boating, though unmeasured, is undoubtedly considerable.

There are numerous boat ramps in the coastal counties of South Carolina and their locations are shown on Atlas plate 29. In Georgia, an earlier study showed 63 points along the coast providing water access for boats (Georgia Department of Natural Resources 1975a). Included in this figure are 20 boat ramps, 26 fishing camps, and 17 marinas (see Atlas plate 27).

These points provide access for recreational boating activities, including fishing, cruising, water-skiing, and sailing. In addition, they provide access to many of the barrier and other coastal islands held in public trust, which are accessible only by boat.

There are 36 marinas in the coastal areas of South Carolina. Locations of these marinas are found on Atlas plate 29. These marinas offer a variety of services to recreational boaters, including moorage, fuel, ice, groceries, bait, and other supplies. There are 18 fishing camps/marinas located in the Georgia coastal areas.

In Georgia, fishing camps are generally located in the less populated and less polluted areas such as McIntosh, Liberty, and Bryan counties (Wilbur Smith and Associates 1975). Camden County has relatively few facilities because it lacks adequate roads to the more remote areas. In contrast, Glynn County has a large number of marinas, largely because

Table 9-20. The number of registered boats in the coastal counties of South Carolina, 1973 and 1977 (South Carolina Wildlife and Marine Resources Department, 1978, Division of Boating, Charleston, unpubl. data).

SOUTH CAROLINA COUNTY	1973	1977	PERCENT INCREASE
Georgetown	3,211	4,027	25.4
Charleston	13,670	16,985	24.3
Berkeley	4,671	6,544	40.1
Dorchester	2,285	3,715	62.6
Colleton	1,535	2,152	40.2
Beaufort	3,503	3,995	14.0
Jasper	689	943	36.9
TOTAL	29,564	38,361	29.8

Table 9-21. Estimated number of fishing trips made in different saltwater areas by private recreational boats during 1973 for South Carolina and Georgia (Bromberg 1973).

	OPEN OCEAN		RIVERS, SOUNDS & BAYS	
SIZE OF BOAT	No. of boats	No. of Fishing Trips	No. of Boats	No. of Fishing Trips
SOUTH CAROLINA				
<16	5,926	69,190	8,081	137,377
16 < 26	6,335	111,561	8,639	135,006
26 +	2,044	20,294	2,787	33,444
TOTAL	14,305	201,045	19,507	305,827
GEORGIA				
<16	8,497	99,208	11,586	196,962
16 < 26	9,083	159,953	12,386	193,562
26 +	2,930	29,091	3,996	47,952
TOTAL	20,510	288,252	27,968	438,476

of a higher economic base, more resort development, larger population, and more urbanization. Chatham County has a full range of these facilities, located primarily along the Intracoastal Waterway.

The Atlantic Intracoastal Waterway (AIWW), the sheltered water route used by boats along the east coast, is a valuable recreational resource in the coastal areas of South Carolina and Georgia. About 240 mi (405.7 km) of the AIWW lie within South Carolina (South Carolina Department of Parks, Recreation and Tourism 1975b). Throughout South Carolina, the AIWW is a series of rivers, estuaries, sounds, and inlets linked by the canals. (For details of the physical attributes of the AIWW, refer to Volume I, Chapter Six.) The migration through and local use of the AIWW by pleasure craft is one of its major functions. It provides varied recreational opportunities for year-round boating, fishing, water-skiing, and swimming. More than 5,000 commercial and pleasure craft pass through South Carolina annually by way of the AIWW (Brooks et al. 1977).

The AIWW in Georgia is a 138-mi (233.3 km) commercial and recreational corridor which winds through the estuarine river system from the Savannah River to the St. Marys River. Land along the waterway is virtually undeveloped for recreational purposes, and its potential for future use is great (Georgia Department of Natural Resources 1975a).

Boating and fishing are the primary recreational activities along the AIWW. Maintained by the U.S. Army Corps of Engineers at an average depth of 12 ft (3.7 m), the AIWW is navigable year around and is a boon for sport fishermen by providing water access to many tidal creeks which offer fishing and marsh hen (clapper rail) hunting opportunities.

Swimming occurs in the AIWW to some extent, but is limited by several factors. The primary limiting factor is access. Private land ownership on either side of the AIWW prohibits widespread use for swimming. Also, no attractive sand beaches, such as those which line oceanfront swimming areas, are available. In areas where the banks have been stabilized for roads and bridges (e.g., Skidaway Island Bridge), swimming occurs frequently. Other factors which limit swimming are high water flow rates and the danger when boats are present. These problems are not as great in the small inlets and pools along the AIWW. It is in these areas that development for swimming logically could occur.

The Georgia Department of Transportation maintains records of bridge openings at each drawbridge over the Intracoastal Waterway. Each time a bridge is opened, the type of vessel passing underneath is recorded. From these records, recent trends in use of the AIWW by pleasure craft, as well as the volume of use in the area of the bridge, show that the two peak periods of AIWW use each year are in the spring (boats heading north) and fall (boats heading south). The records pertain only to large boats which require that a bridge be opened to allow passage; smaller pleasure craft passing under an unopened bridge would not be recorded. Therefore, bridge opening records cannot give an accurate view of the volume of use in the area where a bridge is located.

XI. COASTAL AREA RIVER RECREATION

Concern over the continued modification and pollution of the Nation's rivers, lakes, and streams was, in part, expressed through passage of the National Wild and Scenic Rivers Act (P.L. 90-542) in 1968. This Act was established to protect and maintain selected rivers in the United States for future generations to enjoy vestiges of primitive and wilderness America (Brooks et al. 1977). The criteria for inclusion into the National Wild and Scenic Rivers System require that all rivers in the national system be substantially free-flowing and have water of high quality or water that could be restored to that condition.

The Wild and Scenic Rivers Act declares in part: "Certain selected rivers of the Nation which, with their immediate environments, possess outstandingly scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and they and their immediate surroundings shall be protected for the benefit and enjoyment of present and future generations."

The Wild and Scenic Rivers Act is also structured to strengthen the objectives of State and local participation by providing a means for including select State administered river areas in the national system. Once admitted to the national system, such a river receives full Federal protection.

Because rivers, by nature, are diverse and also because they sometimes are altered by their watershed-use conditions and other such impacts caused by man, the Act establishes four classifications for possible inclusion into the Wild and Scenic Rivers System:

1) Wild River Areas - Those rivers or sections of rivers that are free of impoundments such as dams or other structures and are generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted or capable of being restored to an unpolluted condition. These represent vestiges of primitive or wilderness America.

2) Scenic River Areas - Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds that are still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

3) Recreational River Areas - Those rivers, or sections of rivers, that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.

4) Historic River Areas - Those rivers or sections of rivers that contain remnants of structures or sites of historical significance.

The National Wild and Scenic Rivers Act provided immediate protection to a number of rivers and designated others for study, simultaneously affording the study rivers a certain measure of protection by establishing a moratorium on Federal licenses and by providing assistance for water resource projects within the stretches identified. Much progress has been made toward preserving the Nation's free-flowing streams since passage of the Act in 1968.

The Chattooga River in the Piedmont of South Carolina and Georgia has been designated a National Wild and Scenic River. However, there are no rivers from the Sea Island Coastal Region that are currently being proposed for or are on the National list as Wild and Scenic rivers in either South Carolina or Georgia.

On the State level, South Carolina passed the Scenic River Act of 1974, which authorizes the establishment of scenic rivers and specifies procedures for designating and obtaining certain river segments which possess unique and outstanding scenic, recreational, geologic, fish and wildlife, historic, or cultural values (South Carolina Water Resources Commission 1979). This Act differs from the National Wild and Scenic Rivers Act in that the State: 1) has no purchase authority, 2) has no eminent domain, and 3) can include only a narrow segment of land on each side of the designated river. Lands managed under the system are acquired only by donation. Three classifications are provided for Scenic River designation: Class 1, the Natural River Area, prohibits any construction within its boundaries; Class 2, the Pastoral River Area, permits existing agriculture, silviculture and other human activities which do not interfere with public use; and Class 3, the Partially Developed River

Area, includes rivers affected by the works of man but which still possess actual or potential scenic or historic values. Only the Middle Saluda River, outside the coastal region, has been designated as a Class 1 Scenic River in South Carolina. There are no rivers in the coastal region of South Carolina classified under the Scenic River Act of 1974 at the present time (South Carolina Water Resources Commission 1979).

Georgia's water-use classifications and water quality standards for surface waters include the Wild and Scenic River classifications. Both Wild Rivers and Scenic Rivers are those ". . . so designated by an authorized State or Federal Agency and will be effective simultaneously with that Agency's proper designation" (Georgia Department of Natural Resources 1977c). Only the Chattooga River and the West Fork Chattooga (outside the coastal region) have been classified as Wild and Scenic Rivers. No rivers in the Georgia Sea Island Coastal Region have been so designated.

The Sea Island Coastal Region is interlaced with rivers suitable for fishing, boating, wildlife observation, swimming, and nature study. For a detailed description of the rivers in the coastal region, see Volume I, Chapter Five.

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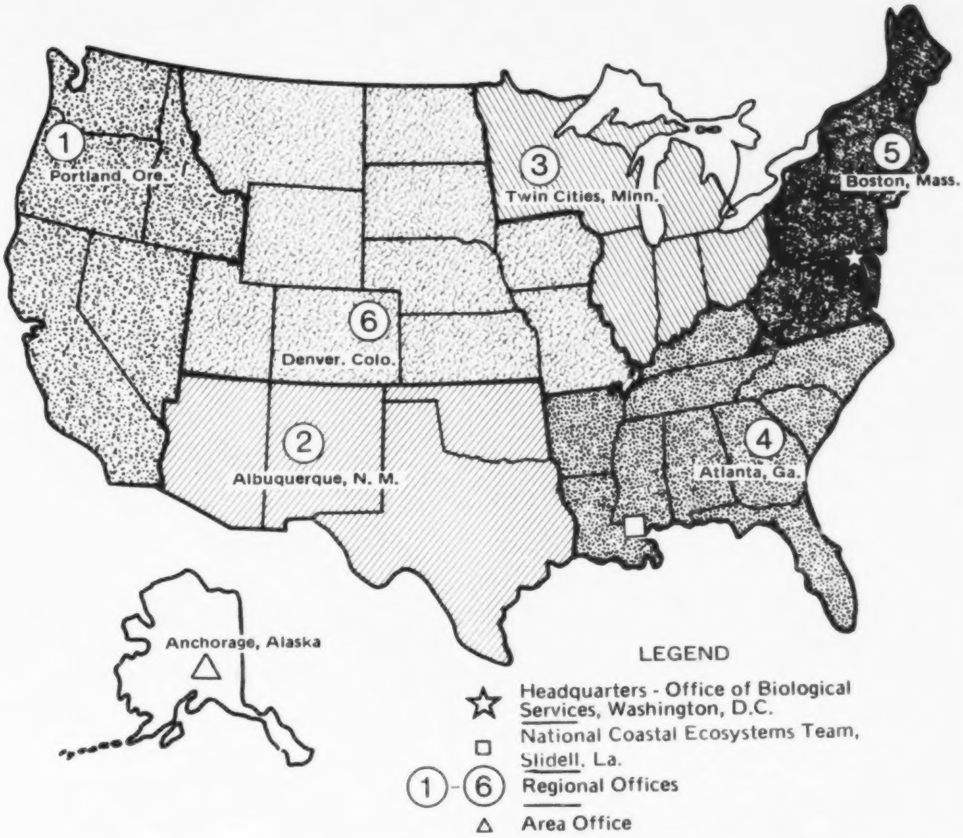
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Portland, Ore.
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Twin Cities, Minn.
5
Boston, Mass.
6
Denver, Colo.
2
Albuquerque, N. M.
4
Atlanta, Ga.
Anchorage, Alaska
LEGEND
☆ Headquarters - Office of Biological Services, Washington, D.C.
□ National Coastal Ecosystems Team, Slidell, La.
①-⑥ Regional Offices
△ Area Office

U.S. FISH AND WILDLIFE SERVICE REGIONAL OFFICES

REGION 1
Regional Director
U.S. Fish and Wildlife Service
Lloyd Five Hundred Building, Suite 1692
500 N.E. Multnomah Street
Portland, Oregon 97232

REGION 2
Regional Director
U.S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, New Mexico 87103

REGION 3
Regional Director
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

REGION 4
Regional Director
U.S. Fish and Wildlife Service
Richard B. Russell Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

REGION 5
Regional Director
U.S. Fish and Wildlife Service
One Gateway Center
Newton Corner, Massachusetts 02158

REGION 6
Regional Director
U.S. Fish and Wildlife Service
P.O. Box 25486
Denver Federal Center
Denver, Colorado 80225

ALASKA AREA
Regional Director
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

March 3, 1849

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.